SCIENTIFIC AMERICAN

JANUARY 1925

35¢ a Copy SCIENTIFIC AMERICAN PUBLISHING CO., NEW YORK $4.00 a Year

The characters in the illustration are from Graham Brothers series of advertisements on "American Industries". The group symbolizes an exhaustive study of the transportation problems of each industry represented—and Graham Brothers policy of building trucks and bodies to meet those problems in a specific, practical way.

GRAHAM BROTHERS TRUCKS

In the Language of the Buyer!

Graham Brothers believe that intimate familiarity with a problem is essential to a *practical* solution.

In accordance with this idea, they began several years ago to make an exhaustive analysis of America's leading industries.

These investigations revealed vital information that has been applied both to the building and selling of Graham Brothers Trucks. Instead of manufacturing to meet general requirements, they build trucks and bodies to meet *specific needs*.

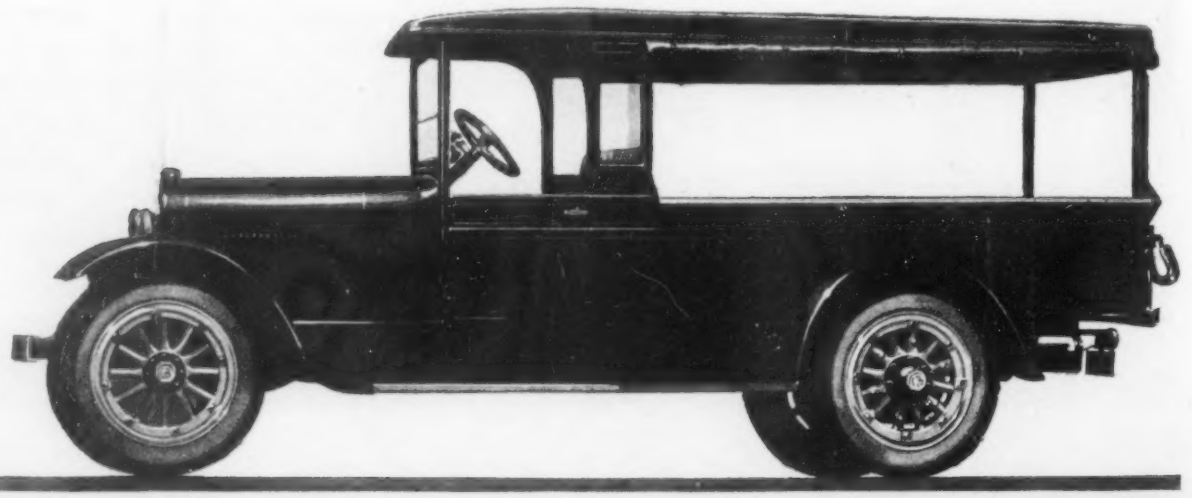
That this specialized method of manufacturing and selling appeals to business men is evident from the fact that a tremendous increase occurred in every industry analyzed, in the exact order in which the analyses were made. In many of the 18 industries upon which the investigations were concentrated during 1923-4, the increases exceeded 1000 per cent and the 18 industries as a whole absorbed 90 per cent of all the Graham Brothers Trucks produced!

In view of these results, it was only natural that the investigation should be extended to include every important business. With this analysis now completed, with a new 1-ton truck, an improved 1½ ton truck and 36 standard body types, it is apparent that Graham Brothers are in a position to discuss any haulage problem—

In the Language of the Buyer!

1 Ton Chassis, $1175; 1½ Ton Chassis, $1375; f. o. b. Detroit

GRAHAM BROTHERS
Detroit, U.S.A.
A DIVISION OF DODGE BROTHERS



The new Graham Brothers One-Ton Truck (open canopy type shown at right) and the improved Graham Brothers 1½ Ton Truck are now being displayed by Dodge Brothers Dealers. Graham Brothers build a standard body for every business, in their own factories at Evansville, Ind.

SOLD BY DODGE BROTHERS DEALERS EVERYWHERE

THE SCIENTIFIC AMERICAN, January, 1925. Volume 132, Number 1. Published monthly by Scientific American Publishing Company, at 233 Broadway, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

Invention

ONE of our friends, Mr. William Simms Prosser, of California, is not as happy about our accomplishments as he used to be. "Once," he writes, "the Scientific American was a fine journal of science; now it is a mere museum of freaks—a hunter of spooks, of gold from sea water, of a Keely motor, of Einsteinism, of a fourth dimension and a string of such junk. In some exalted moment you may offer $5,000 for a method to make cats with a head on each end so as to catch twice as many mice."

Maybe we will. It is certainly an idea. And no one can say that we ever discouraged American inventiveness.

Brickbats

THE announcement of our intention to try transmuting quicksilver into gold has brought down on our more or less defenseless head a glorious shower of verbal missles. Professor Sheldon and ourselves have been accused of misdemeanors ranging from scientific idiocy to international and financial blackmail.

We have received some fifty offers of "secret" processes by which gold can be made—it is said—at once, without the labor or expense of any scientific research at all. On the other hand some of our good scientific friends insist that transmutation is hopelessly impossible.

Well, possibly it is. That is just what we are trying to find out. But impossibilities are few. We believe that gold can be made. But we do not expect to get rich out of it nor to upset anybody's banking system. All this we have explained already but it seems to be necessary to say it again.

Nuggets

OUT of what our friends of the newspapers have said about our gold investigation we have picked up two nuggets of pure felicitous phrase. One of them is the idea that one can "crack" an atom, as one cracks petroleum, and make it into something else. For vividness—and, withal, for accuracy—it is hard to find a better description for what we are trying to do. We don't know which newspaper man made this phrase in the beginning. We wish we did. He has our thanks.

The other phrase is good enough for a detective story. We find it in the Tarrytown, New York, *News*. The Editor of this paper writes of our search under the head of "The Eightieth Electron." He has in mind, of course, the fact that an atom of gold has seventy-nine planetary electrons while a quicksilver atom has eighty. Take off the eightieth electron and you have gold.

Now some one must write a story to go with that title. The Mystery of the Eightieth Electron!

Abrams

THE older books of natural history used to describe a kind of snake discovered by explorers and which, when cut in two, wriggled off as happily as before; more happily, indeed, for there were now two complete snakes instead of one.

In This Issue

The Truth About Radio Sets

In our new radio department on page 41 of this issue the experts of the Scientific American give you exact, dependable facts about the cost, range and character of ready-for-use radio sets now on the market. Don't buy a radio set until you have read this department.

Nature's Grandest Spectacle

People who live in the eastern part of the United States will soon have their only chance in nearly a century to see a total eclipse of the sun. Turn to page 13 and decide now where you will take your station to see this unforgetable natural marvel.

Before You Buy Your New Car

Read the article by Mr. Slauson on page 5. Developments of automobiles in 1924—improvements in sight for 1925; you must know these facts if you are to get full value from your purchase of a car this year. All the cars of the year are listed, with full information, on pages 68 to 71.

Germany's New Sail-less Ship

On page 12 is a pictorial description of the newest marvel of German engineering skill, the famous "rotor ship." It uses wind but has no sails, only a pair of upright towers like great stovepipes.

Why People Get Tired

The reason is too much lactic acid in the blood. Lactic acid is the acid contained in sour milk. "Your relation to lactic acid may determine your success or failure in life," says Professor Hill, whose remarkable new work on the chemistry of exercise is described on page 10.

Leviathans of the Air

Business men who are far seeing enough to be interested in the possibility of bringing mails, passengers or freight from London within two days should read Professor Klemin's prophetic articles on gas-filled airships. They begin on page 18.

More Than One Hundred Pictures

Complete Table of Contents Will Be Found On Page 72

For Next Month

Is There One Pure-blooded Man or Woman in the United States?

Probably not, say the scientists whose investigations are reported in a remarkable article on racial differences which we will print in the February issue, out January 20—the first of our series on the scientific problems of immigration.

The Wonder World Inside the Atom of Matter

Billions of atoms can crowd together on the surface of a pinhead. Inside this tiny atom lie the secrets of inexhaustible power, of gold from quicksilver, perchance of life. A picture feature next month will make this clear.

Can There Be Life On Our Sister Star of Mars?

When the red planet was close this summer astronomers made many observations. Some of these indicate a thick atmosphere, a considerable warmth. Does this mean life—plants, animals, intelligence? Perhaps. Professor Russell will describe these discoveries next month.

OTHER ARTICLES on Clues of Hair—The Eclipse—Aviation—Radio—The New Los Angeles Water Project—The Einstein Theory—Inventions—The Novel Three-Cylinder Locomotive.

More Than One Hundred Pictures

¶ You will be sorry if you miss this next issue. Why not send us a dollar for a three months' trial subscription?
That's right!
Thanks!

There is a certain parallelism in what seems to be happening to the procedures of Doctor Abrams—the notorious E. R. A. Supposedly killed by the adverse results of many scientific investigations, including those made by the Scientific American's Committee, the Abrams foolishness seems to be splitting up into a number of separate snakelets of quackery, each of which claims to be an "improvement" on the discredited technique of the late Doctor Abrams.

The public should remember that a medical procedure which claims to be based on any variety of "electronic" or "protonic" or "vibrational" action cannot possess, in the present state of knowledge, any solid basis of scientific fact. We do not know enough yet about electrons or vibrations to be able to use them in medicine.

Oil

OUR readers will be disappointed to learn that Mr. Walker, who began some weeks ago the investigation of the oil industry which we promised on this page in our November issue, has been seriously ill. Necessarily, the investigation has been delayed.

We are glad to say that Mr. Walker is recovering satisfactorily. He expects to be able soon to take up again the threads of his oil inquiry.

Records

THAT athletic honors from running records to the heavyweight championship of the world, are not the result of vigor or of determination but merely of a certain bodily capacity for chemical reactions is the startling conclusion reached by Professor Hill and described by Mr. Duffus in this issue. Jack Dempsey is merely a good sort of test tube.

Mr. Duffus' article is the first of a series that we expect to offer during this year on the basic science that underlies athletic sports. The football championship may have been decided—who knows?—by the density of the air some day as compared with the air-pressure inside the ball used in that particular game.

China

WE have made another bust. On page 418 of the December issue we speak of the Great Wall of China as being thirty feet thick at the bottom and "dwindling to twenty meters at the top." Rather a peculiar way to "dwindle," our correspondents think, since twenty meters equals some sixty-five feet.

Of course what we should have written was "dwindling to twenty *feet* at the top." All the figures were in meters originally. We translated the figures but forgot to change the units. Sorry.

Why

A FEW readers may miss our familiar Editorial page this month. The reason for its absence is that just as we are rushing to press, there arrive from Europe the facts and pictures on the new German rotor ship invented by Dr. Flettner. There was only one place to put this material in this month's magazine. The Editorials had to drop out,

EIGHTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JANUARY, 1925

What Should We Expect of Tomorrow's Motor Car Developments?

By H. W. Slauson, M.E.

IF WE were to predict that by the end of the next decade, motor cars would be self starting and self lubricating, and in fact nearly automatic in control, we would justifiably be classed as dreamers —for the human mind must always control the direction, speed and destination of the motor car.

But motor engineers are rapidly approaching this ideal design in which a minimum of effort and thought is required to operate and maintain the automobile of the immediate present and that of the near future. Press a button, and the entire chassis is lubricated; push the foot accelerator and the eighty horsepower is released with the smooth flow of steam; touch the foot brakes, and the forward motion of the car is retarded by a mechanism operated by the very momentum which makes the stopping effort necessary; turn the steering wheel with the little finger, and the direction of travel of a 5,000-pound car can be changed; hit a hole in the road, or even a curbstone, and the shock will be absorbed by the various easy-riding devices so that the occupants will feel scarcely a jar; pour a certain colored fuel into your gas tank, and carbon formation will be either delayed or eliminated.

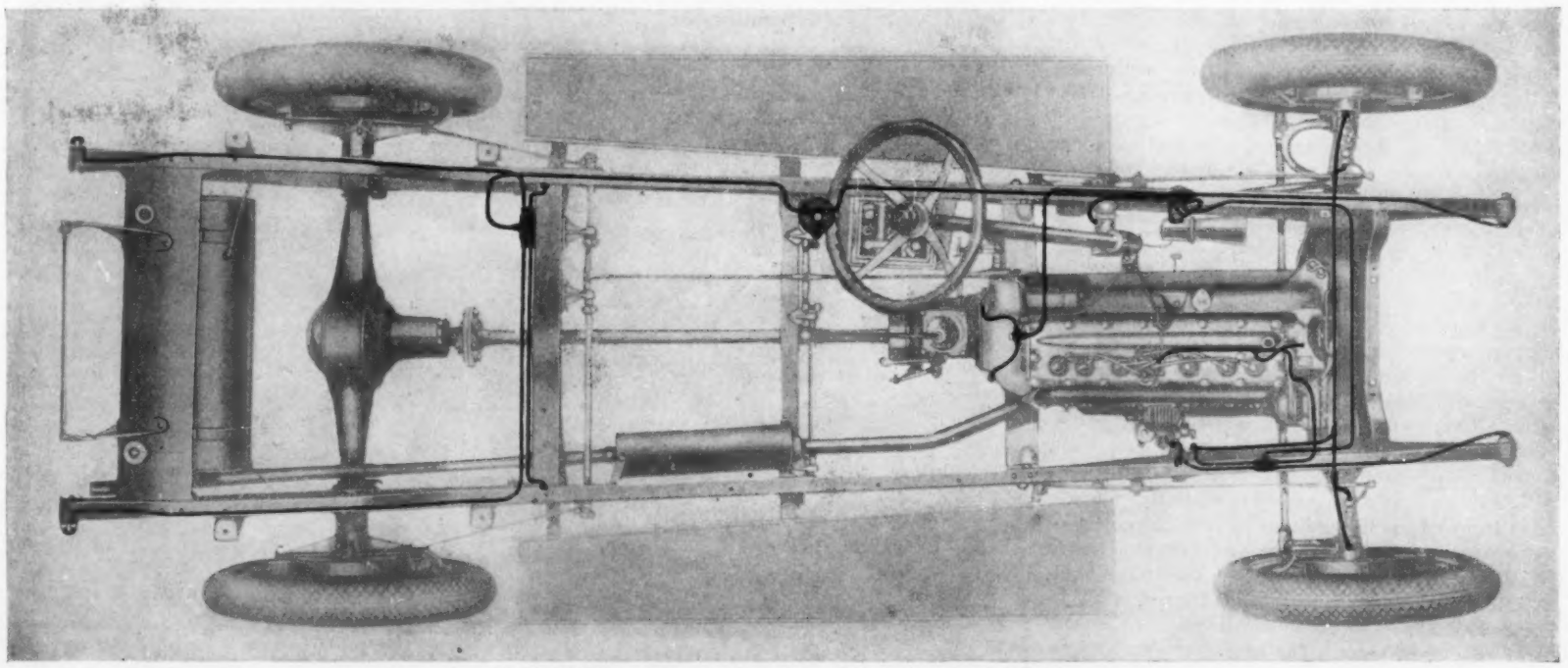
SIMPLICITY ITSELF

One push of the button and the entire chassis is positively and thoroughly oiled

These advances in design are accomplished facts, either already attained by the late cars of 1924, or certainties for those of 1925.

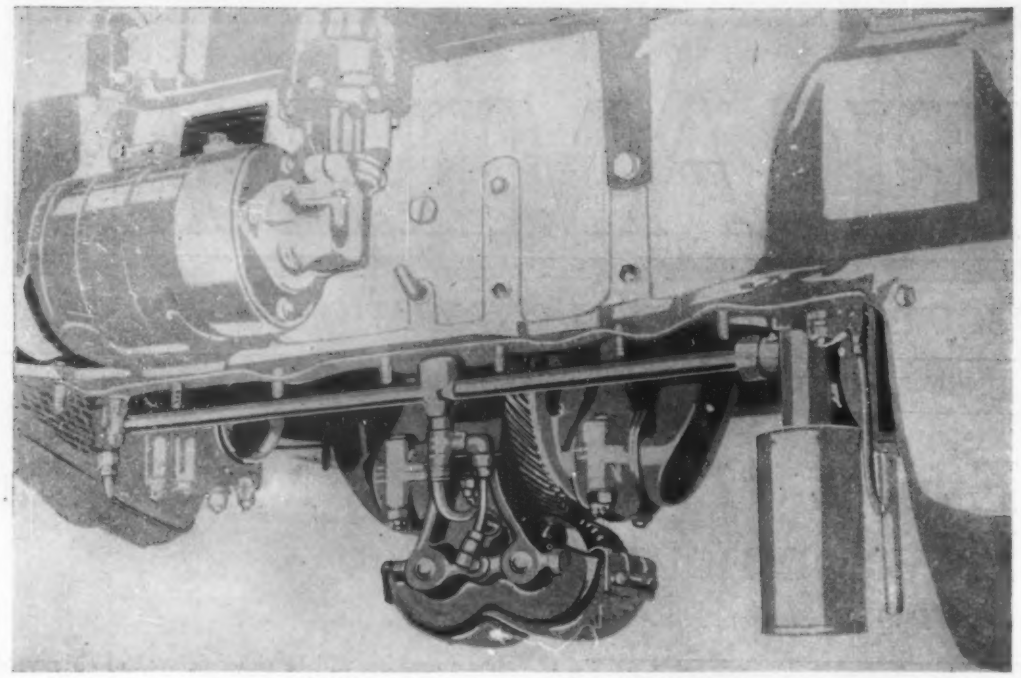
Comfort and safety are closely allied, for it certainly is not comfortable to drive the most easy-riding car in the world if we entertain doubts as to its ability to stop in time, or are constantly wondering as to the strength of the steering knuckles or other parts subjected to terrific strain. Therefore, when we say that the tremendous popularity of the balloon tires has resulted in their adoption by a large number of manufacturers as regular equipment, we must point out that the front wheel bearings have been redesigned to reduce wear, and that the entire steering layout, in fact, has been entirely changed to meet these new conditions. Balloon tires, with their wide area of contact, cannot help but turn hard for the same reason that we cannot "about face" easily on the flat sole of our foot, but must concentrate the weight on a smaller point.

Therefore, steering gear ratios have been changed from 7 and 8, to 1 to 10 and 12 to 1, with the result that, while a greater amount of turning of the



PRESSURE-FED OIL LINES LEAD WHEREVER NECESSARY

The vital parts of this chassis may be thoroughly oiled even while the car is in motion



THIS NEW DEVICE HELPS REDUCE VIBRATION

The vibration inherent in any four-cylinder motor may be reduced so greatly that its operation becomes as smooth as that of a six-cylinder motor

steering wheel is necessary to round a sharp corner, the effort required to deviate the heavy car from its course is almost nothing. The delicacy and ease of steering have thereby been increased, although the "castor effect" which tends to keep the car straight and to assist it in resuming its direct path, has been retained. These improvements in steering mechanisms, and the use of frictionless bearings at the steering pivots, are characteristic of many of the new cars, regardless of whether they are originally equipped with balloon tires by the manufacturer, or not.

But balloon tires are by no means perfect, and while they overcome many riding ills, they may develop some faults all their own. One of these is the pitching or galloping of the front end, due to the excessive cushioning provided by the springs and soft tires. This has given an opportunity for shock absorber manufacturers to come to the rescue by developing a new type of recoil check which acts in proportion to the upward thrust of the car body. The annoying cumulative effect of the pitching is thus reduced, and each miniature thank-you-ma'am in the road isolated in its effect on the occupants.

If physical riding comfort means freedom from jolts and jars, we must presuppose the ability to drive at high speeds as a logical sequence, but high-speed travel over rough roads means unusual stopping ability. Balloon tires in themselves offer considerable stopping effect when the rear-wheel brakes only are used—owing to their larger area of contact —but inasmuch as braking effort also depends largely upon the weight involved, we can only get the maximum effect when the brakes are applied to all four wheels.

Thus we can definitely say that four-wheel brakes have come to stay, and that of the large number of manufacturers who adopted them last year, none has given up their design, and many recruits have been added to the field.

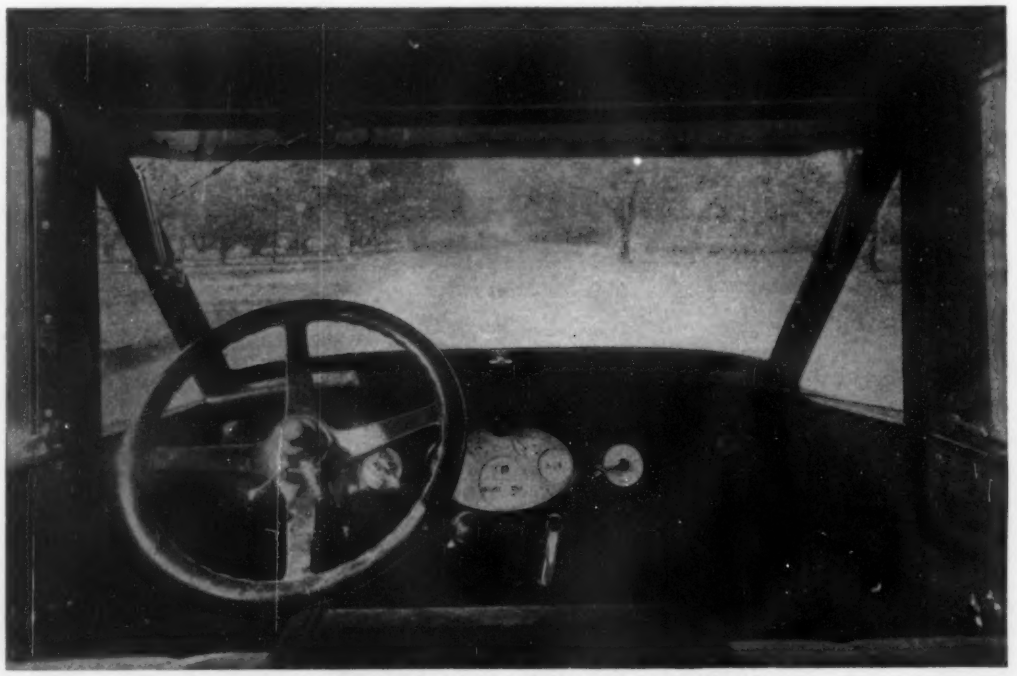
In this country, the application of brakes has always involved the expenditure of physical power—the quicker we wanted to stop the more muscle we must use. In this respect, European design has been a little in advance of us, for in Europe, what is known as the "Servo-mechanism" has been employed for a number of years. The term Servo-mechanism merely means that power derived from the engine or from the momentum of the car itself is used to apply the brakes. The operation of such brakes is similar in effect to the depression of the foot accelerator. When we need more power to increase the speed of the car or to climb a hill, we obtain it from the engine without exerting any more personal physical effort. Merely the *degree* to which the accelerator pedal is depressed determines the amount of power to be delivered by the engine. So it is with the Servo-brake mechanism, when we want more stopping power, we merely depress the brake pedal to a greater extent, without exerting any more physical effort.

Several cars have been equipped with a Servo system in which the forward-rolling tendency of the car is used to apply the brakes after contact has once been established by means of the pedal. Another development recently announced is somewhat different in its action, and is a hydraulic system dependent upon oil pressure generated by a pump located in the transmission case. This pump is directly connected with the transmission gears, and thus operates whenever the wheels turn. Under ordinary conditions of car travel, the pump does no work other than to circulate the oil back into the transmission case. When the foot brake is pressed, however, the oil return pipe, or bypass, is closed, and the oil is forced into the tubes connected with each of the four brakes. The greater the depression of the brake pedal, the higher is the pressure which is built up and transmitted to the brake bands. But this condition applies only so long as the rear wheels keep turning—and here is one of the interesting effects of such a design.

Any motorist knows that skidding can only occur when the wheels slide, and that the remedy for a bad skid is to release the brake until the wheels can obtain a new bite on the roadway. The transmission-driven, hydraulic brake system just described, takes care of this automatically; if the brake pedal is depressed so far on a slippery day that the wheels become locked and do not turn, the transmission-driven pump stops its work, the pressure actuating the brakes is relieved, and the brakes are released. This permits the wheels to revolve again, and as soon as this occurs, the brakes are once more applied, thus resulting in a maximum stopping effect, with a minimum tendency to skid.

Comfort and mental relief in driving create a tendency for excessive use of the car and for longer tours and trips. The motorist returning from a long and severe tour, however, must pay the penalty of excessive car use, and must either give his car a thorough greasing, or have it done at a local service station more or less effectively, and at a more or less excessive price.

Such a man will be more than interested in the automatic lubricating systems which have been developed and are to be a part of a few of the cars now on the market. In this system, a main oil reservoir connects with shackle bolts, steering pivots and other parts of the chassis, requiring frequent lubrication. The copper pipes conveying the lubricant are carried along the inside of the frame channel, where they are well protected from breakage. A small plunger pump, capable of exerting more-than-adequate pressure, is placed under the front floor board of the driver's compartment where it



THE DRIVER HAS CLEAR VISION AT ALL ANGLES

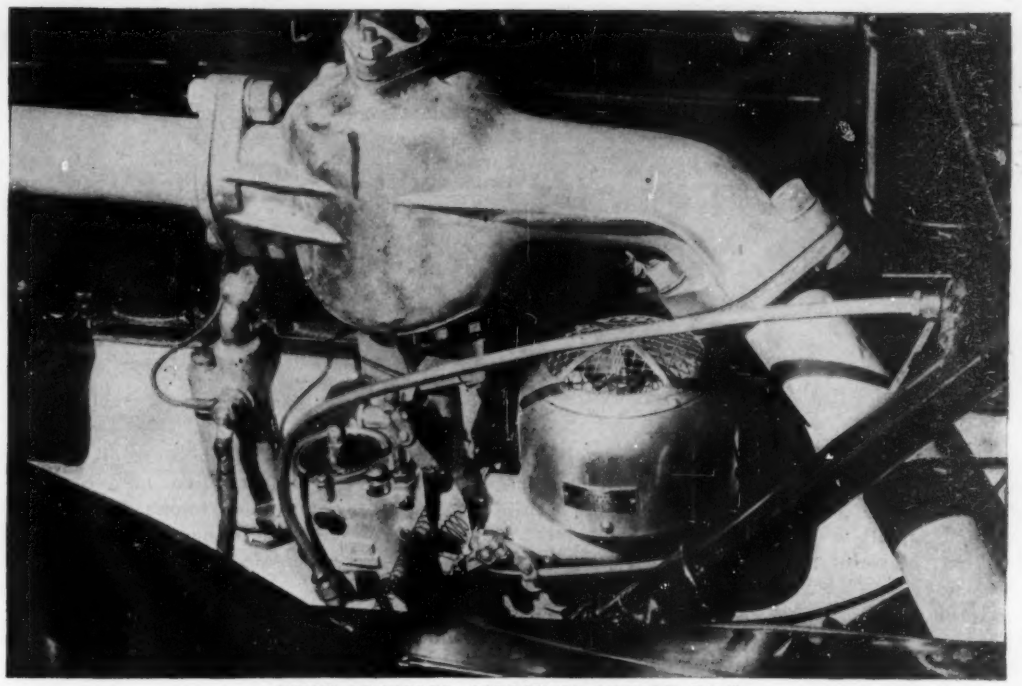
In this model the famous and dangerous "blind spot" has been eliminated by a happy application of the body designer's art

may be actuated by his heel whenever he deems that a "shot" of oil would be beneficial to any part of the chassis. Thus the entire car may be completely oiled, even when traveling at fifty miles an hour. Such a development naturally tends to prolong the life of the car mechanism, for hidden grease cups, otherwise neglected, will automatically receive their meed of oil.

But if comfort, safety and convenience represent the development in the efficiency of the car as a whole, the development in the efficiency of the motor has been even more amazing. The bore of a motor, or its size, is no longer a criterion of the power that it can develop, not only because a cubic inch of piston displacement develops more power than ever before, but also because that power is more efficiently applied. Engines of from forty-five and fifty horsepower up to ninety horsepower are the rule now, rather than the exception. Some of this greater power is to be obtained by the increased use of eight cylinder engines, in place of the fours and sixes.

The increased popularity of the engine having eight cylinders in straight line has been due to the design which has served to eliminate vibration. A few years ago, engineers thought that the six or twelve-cylinder engine represented the best inherent balance of moving parts and of periodic explosions. The eight-cylinder engine with all its cylinders placed in line, was but little better than the two or four-cylinder engine coupled together. By setting certain crank throws of the eight-in-line engine at right angles, however, explosions and inertia of moving parts were enabled to counter balance each other as effectively as in a six-cylinder engine, with the result that the modern straight eight represents a smooth and uninterrupted flow of power.

The virtual elimination of the annoying "period of vibration" in a gasoline engine represents one of the most interesting developments in motor car design. We all remember some critical speed at which certain motors would begin to create a veritable St. Vitus Dance in lamp-brackets, loose fenders, or rear view mirror. This is because the "period" or length of vibration wave of the part in question corresponded exactly with the vibration set up by the motor at that speed. Thus the vibrations of the engine were added to those of the lamp-bracket or other loose part, the effect was built up, and became cumulative.



MUCH SO-CALLED CARBON IS MERELY DIRT

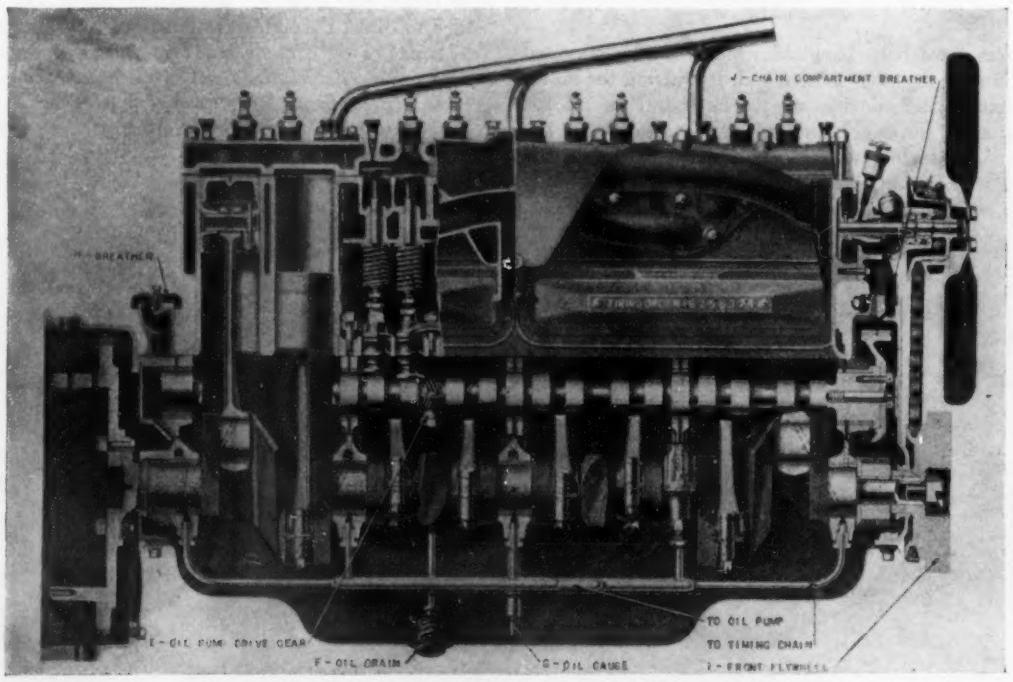
Scientific studies have shown that the "carbon" in cylinders may be forty percent road dirt. This filter for the air fed to the engine does much to overcome carbon trouble

The change in the period was brought about as already described and may be likened somewhat to the ingenious device originated by a building engineer to eliminate vibration in a tall office tower. That tower-like building, rigid as it was, nevertheless possessed a certain period of vibration. It was topped by a large flag pole which, naturally, would sway back and forth in the prevailing strong winds. It happened that the vibration period of this flag pole exactly corresponded with that of the building, with the result that the vibration of the two built up until the swaying of the flag pole produced a very severe rocking effect on the entire building. This trouble was not overcome by the removal of the flag pole, but merely by a change in the period of vibration, to make it different from that of the building. A heavy iron collar was placed around the flag pole, which was anchored at this spot, with the result that its length of vibration was changed. Thus, instead of being added to, the vibration of the flag pole neutralized that of the building, which is now steadier than would be the case were no flag pole used at its top.

The elimination of engine vibration has given body designers an opportunity to improve the appearance, convenience and utility of the most essential parts of the now popular closed car. The new bodies will be considerably lighter, not only because the reduction of vibration makes possible structural changes, but also because a new type of pressed steel body has been developed. The drumming effect which engine vibration formerly induced in the metal roof of a closed car has been overcome, and for 1925 we will find comfortable, and even luxurious, wind and weatherproof bodies, mounted on cars which sell at lower prices than ever before available for the same degree of dust and weather protection. The all-steel body, as its name implies, requires no wood in its construction. The supports are as light as possible and yet are strong and rigid. Such a body is indeed machine fabricated and while the old body builders' art may still be found in the upholstery and interior fittings, the body shell itself is the work of mechanical presses.

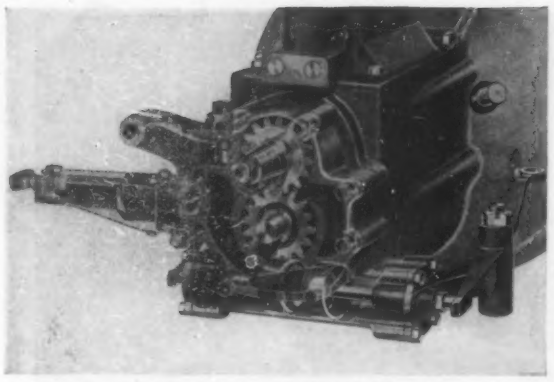
As might be expected, the very seat of car comfort is the upholstery and cushions. Easy seats and backs make for armchair luxury, but on the other hand, too great a flexibility is to be avoided, for this will greatly increase the polishing action between the vertical upholstery and the rider's clothes. This annoying condition, however, has been ingeniously overcome by a construction in which the back of the upholstery is hinged to the rear edge of the seat, in such a manner that the vertical piece slides up and down with the motion of the passenger's body. This means that, no matter how great the vertical movement of the passenger, there will be no rubbing between his back and that of the seat against which he rests.

If engineers are given stronger materials with which to work, they can reduce the size, as well as the weight. The use of metal pillars in automobile bodies increases the width of window space, as it reduces the size of the material necessary. The cars of tomorrow will have fewer "blind spots" and a greater area of free window space. This not only makes for greater comfort and enjoyment of the



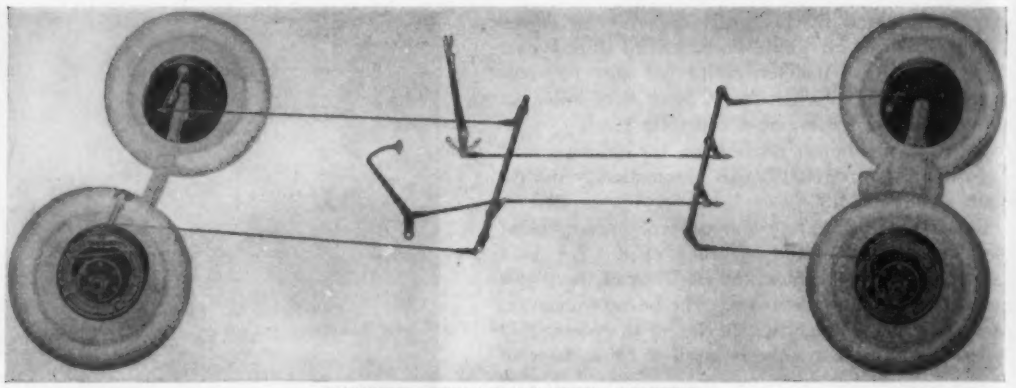
THE NEWEST DESIGN FOR AN EIGHT-IN-LINE MOTOR

The bugbear of vibration in the eight-in-line engine has been eliminated by an especially designed crankshaft, by bearings of generous size and by accurate finishing of all moving parts



GEARS DRIVE BRAKE SYSTEM

This oil pump furnishes power for the brakes as illustrated below

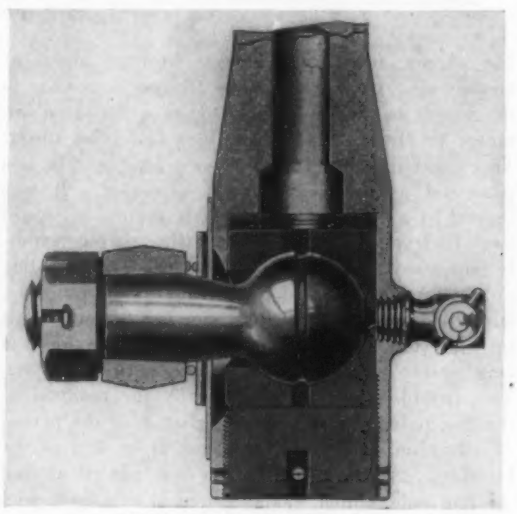


ANOTHER UNIQUE BRAKING SYSTEM

Four-wheel brakes which are applied by power drawn from the rotation of the wheels themselves

occupants, but actually adds to the safety of car operation, for many an accident has been caused by the pedestrian or oncoming car which has been concealed behind the windshield support or other pillar on the side of the driver's compartment. In this connection an interesting phase of human nature is to be observed. Motorists have agitated the elimination of blind spots, and yet such agitators are doubtless the very ones who add blind spots to the front, sides and rear of their cars in the form of bathing girl posters and club stickers. So widespread has this practice become that the Motor Vehicle Commission of several of the states have forbidden the use of any posters, pasters or other form of advertising literature which will in any way obstruct the view of the driver or occupants.

But engineers and designers have not solved *all* motoring problems, nor have they overcome other difficulties that beset the owner. Instruction books urge us to change the engine oil every five hundred miles or so. This is made necessary by the accumulation of water, condensed gasoline, carbon and other foreign materials which mix with the lubricating oil and destroy its efficiency. Carbon is a combination of a gummy deposit left by the incomplete combustion of the gasoline and the road dust which is always raised, even from our hard surface highways. In some instances, as much as forty percent of the so-called carbon formation has been found to consist of road dust or silica, which is nothing but pulverized rock. Some motor car manufacturers have therefore taken a hint from the designers of tractors and have installed filters or air cleaners which serve to remove all of the dust and other foreign matter from the air before it is breathed into the engine cylinders. However, in spite of these attachments and precautions, it is necessary to drain the oil from the crankcase every few hundred miles. This can only be done by draining the crankcase, and if there was ever a dirtier job to be performed from a more uncomfortable position, we would like to know it. Crankcase oil should be drained because it becomes dirty, and yet the ordinary drain plug under the crankcase cannot be removed without receiving a shower of oil upon the hand that wields the wrench. From his reclining position underneath the car, from which he must reach up to remove the plug, old oil is bound to run down the hand and arm, and to soil the clothing of the luckless owner who religiously adheres to these instructions for lubricating. In some cars,



FOR EASIER STEERING

Oil applied to the steering linkages helps control of balloon-tired cars

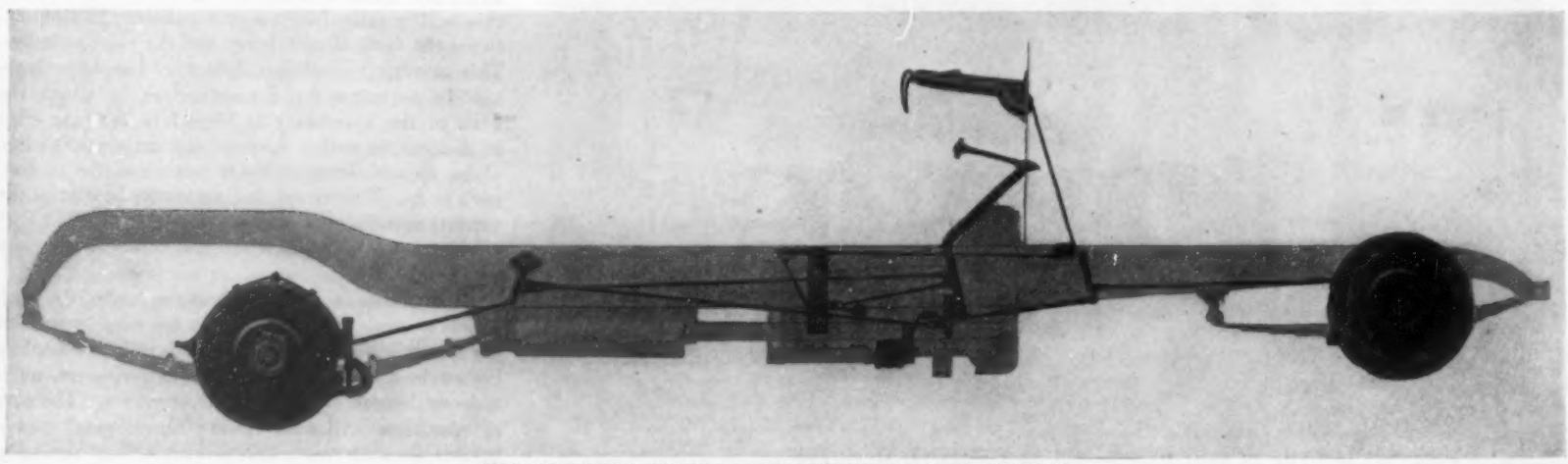
valves have been installed which may be operated by a cock or lever control rod, by raising the motor bonnet. Such devices are to be found on all too few cars, however, and design in this respect has made but little advance since the days of the earliest one and two cylinder power plants.

Another lubrication lack is the means furnished by the manufacturers to keep the springs which support the car, well oiled. There are no busier parts of the automobile than the individual leaves of which these springs are composed. Every bump or inequality in the road causes a rubbing action throughout the entire length of each leaf. These springs are subjected to all of the mud, dust and water of the road; consequently they become rusted and gritty after a few weeks of use. There are plenty of penetrating oils on the market, and many makes of spring covers which will retain the lubricant and exclude dirt and water. But few cars, however, are initially provided with this armor, even the permanent easy-riding qualities of which the manufacturer may make so much, are practically dependent upon maintaining a clean and well-lubricated friction surface between these leaves.

Rapid developments have been made in batteries and starters. Such systems seldom give trouble. Rapid strides have also been made in the laws of various states governing the use of headlights. Many ingenious lenses and reflectors have been devised to direct the rays from the headlights downward to illuminate the road, where light is needed, instead of upward to illuminate telephone wires and other high objects. The trouble with the majority of such devices, however, is that they must be used in connection with properly focused bulbs and correctly adjusted headlights. Different types of bulbs require a different focus in the headlamp and frequently a bent fender or a slight collision will tilt a headlamp upward instead of straight ahead. Under such conditions reflectors and lenses which are intended to direct the light rays downward are useless.

The names of cars designed in accordance with the preceding descriptions will be sent on request. We also will welcome suggestions from readers as to how the modern motor car may be further improved.

¶ *A tabulation of cars of 1925 will be found on pages 68 to 71 of this issue.*



THE OIL-DRIVEN SYSTEM OF FOUR-WHEEL BRAKE CONTROL

In this system the power for applying the brakes is obtained from the oil pump illustrated above, which pump is driven by the transmission

Ewing Galloway

Mt. Shasta's Mighty River of Mud

ONE of the most curious phenomenon of glacial history occurred recently in California, where a warm and dry season, unusually prolonged, so melted one of the large glaciers on the south side of Mt. Shasta as to set in motion a veritable river of mud and rubble, which in the short period of two weeks completely altered the topography of an entire valley.

Whereas, glacial motion is ordinarily infinitely slow and its visible effects are the result of years and centuries rather than of days and weeks, this recent flow was so rapid that it endangered the little town of McCloud, south of the mountain.

Owing to the geologic formation of the mountainside, composed largely of a combination of volcanic ash, sand, and pumice, the moving stream gathered in its passage a tremendous accumulation of debris. As the body proceeded down the steep slopes it cut channels through the deposits of crumbly ash left by a former volcano, creating deep, miniature canyons. The walls of these were continually undermined and frequently caved in, temporarily clogging the flow. The banked up accumulations became so heavy as to break through these dams, releasing thousands of tons of mud and giving the entire mass fresh impetus.

Mud was deposited over an area ten miles long and about three-quarters of a mile wide. Vegetation was submerged. Small animals such as squirrels and chipmunks were trapped and buried.

As the deposit hardened under the hot sun it solidified to a jelly-like consistency and would support the weight of a man. Later it dried and hardened into a firm, pumiceous earth. Owing to the large percentage of sand in its composition the new floor of the valley is brittle and can easily be crumbled in the hand. It probably never will support so varied a vegetation as the richer earth it covers.

The south slopes of the mountain from an altitude of about 10,000 feet, where Whitney glacier lies, were considerably altered during the period of the flow. Observers say that repeated winters of light snowfall, combined with hot summers, inevitably will change the aspect of the entire mountainside and cause similar flows from the glaciers reaching into the higher altitudes.

GREAT STONES ROLLED ALONG BY FLOOD

Boulders were carried down the mountain side and thrown against trees, many of which were cut down or broken off

FORESTS OVERWHELMED BY MUD FLOW

The main stream of Mt. Shasta's river of mud as it appeared in September. A new channel is being cut through the material deposited a few days earlier

What Causes and What Cures Fatigue?

Recent Remarkable Experiments by Professor A. V. Hill that Show How the Chemical Called Lactic Acid Controls the Action of Our Muscles

By R. L. Duffus

THE belated commuter grabs his hat and coat, dashes down the front steps, sprints a quarter of a mile down Main Street, and reaches the railway station just in time to catch the last car of the 8.17. He sinks breathless into the nearest seat. His pulse is beating rapidly, his hands shake as he unfolds his morning paper and he is tired enough, especially in the legs, to be glad to sit still for half an hour or an hour. These sensations are familiar to everyone. In an acute form they are the common experience of every athlete.

What is behind these sensations? What actually happens when we get out of breath or become exhausted? Why cannot an athlete keep on running indefinitely or a bricklayer continue to lay bricks indefinitely? If these questions could be fully answered much light would be thrown on problems of work and play.

Dr. A. V. Hill, professor of physiology in University College, London, recently set out to answer some of them.* He discovered that there was a very close relation between the fatigue caused by exercise and the production of a certain chemical called lactic acid in the muscles that were being used. When a man is running at full speed, about three grams of lactic acid is produced each second inside the substance of the muscles.

Lactic acid is, by the way, the chemical which gives the sharp, acid taste to sour milk. What Dr. Hill has found, therefore, if one cares to put it that way, is that the real basis of muscular fatigue is the accumulation in the muscles of this acid which we may take into our stomachs, not only without harm but often with decided benefit.

Dr. Hill began his experiments, as other scientists have done, with isolated muscles of frogs. These muscles, if carefully taken out, will remain alive; that is, will contract if stimulated, for a considerable length of time. They become tired, however, after repeated stimulations. If they are deprived of the oxygen gas such as we breathe from the air, or if they are exposed to a temperature as high as 35 degrees Centigrade, they will die. It was easier to observe these phenomena than to account for them, until Dr. Hill discovered that fatigue and death of such isolated muscles were accompanied by an increase in the amount of lactic acid present in the muscle, whereas recovery from fatigue was always marked by a decrease in lactic acid.

But even that marvelous machine, the human body, cannot perform impossibilities. It was apparent that the lactic acid could not have been made out of nothing but must have been formed from some substance already existing in the muscles. This, it appeared, was glycogen, a chemical composed of a combination of carbon, hydrogen and oxygen and always found in the body tissues. Whenever a muscle contracts a certain amount of glycogen is transformed into lactic acid. When, on the other hand, the muscle is allowed to rest, this lactic acid is transformed back into glycogen. It is the transformation of the lactic acid in his muscles back into glycogen that enables the commuter to recover after his dash to the train.

These processes can be measured with almost absolute accuracy. One method is to measure the amount of heat produced, using for this purpose an instrument capable of recording one one-hundred thousandth of a degree Centigrade. For every gram of lactic acid developed during exercise it was found that 370 calories of heat were produced and for every twitch of a frog's muscle it was found that the temperature of the muscle was raised about 3/1000th of a degree Centigrade.

When the muscle was allowed to rest the opposite process took place. Again 370 calories of heat were absorbed, this time in turning the gram of lactic acid back into glycogen.

But as in biology, just as in ordinary life, it is not possible to get something for nothing, and out of every five or six molecules of lactic acid taking part in the process one is used up in the conversion back into glycogen. This molecule furnishes the necessary energy to carry on the process. It furnishes this energy by virtue of a chemical change analogous to combustion. The lactic acid combines with oxygen, much as coal does when it is burned.

For this reason the isolated frog muscle must be provided with oxygen or it will die. Similarly the living frog or a higher animal must breathe. For, Dr. Hill was able to prove that the same laws of physics and chemistry which rule the twitchings of frogs' muscles control the use of the muscular systems of human beings.

He did this by careful experiments with athletes, before, during and after strenuous exercise. Lactic acid in the muscles cannot easily be detected while the subject is alive, but, fortunately for Dr. Hill's experiment, the acid shows itself in maximum quantities in the blood about ten minutes after it has reached its maximum in the muscles. By testing the amount of the acid in the blood it was possible, to measure the effects of fatigue accurately.

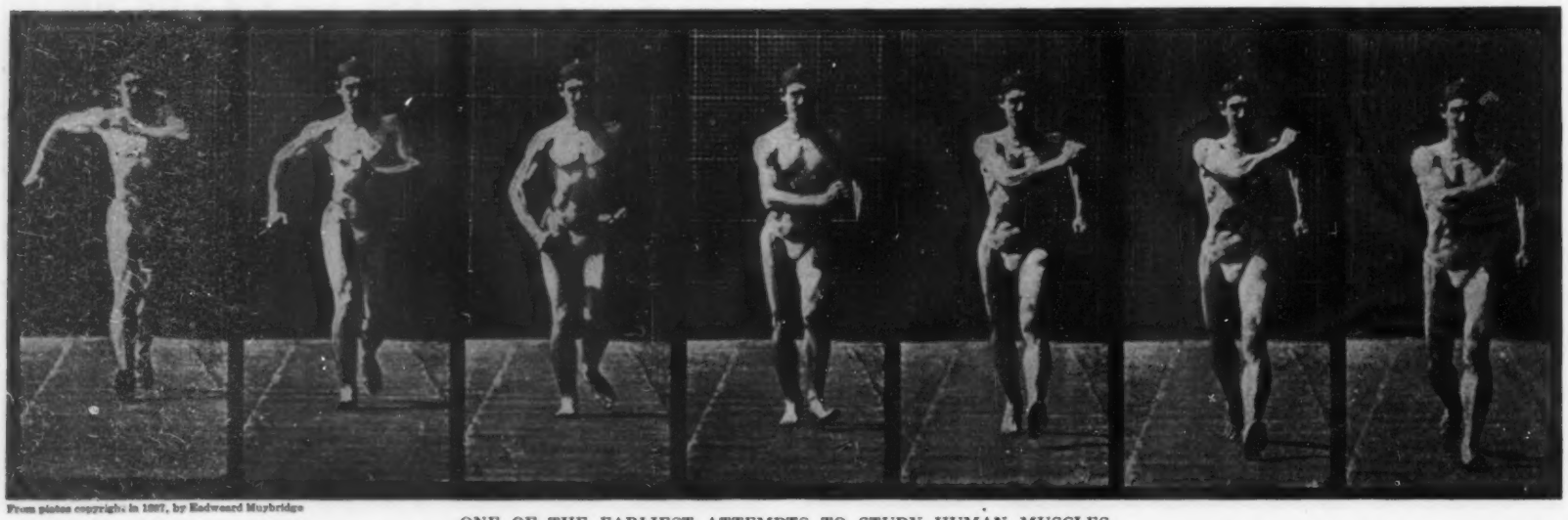
The results proved to be amazing. Lactic acid in the blood of a resting man forms between 0.01 and 0.02 percent of the blood contents. After severe exercise it may rise to as high as 0.20 per cent, or, as in one recorded instance, 0.35 per cent.

This increase in the amount of lactic acid in the blood corresponds to what scientists call the "oxygen debt" of the body—that is, the amount of oxygen which the body must take in before all the lactic acid developed during previous exercise will have been turned back into glycogen. This corresponds to the energy actually lost as a result of the exertion undergone. It is why you pant after exercise. The body is recovering its "oxygen debt."

But perhaps the most interesting part of the experiments is what actually happened, together with the rate at which it happened, when violent exercise began. Obviously a man beginning to run, whether to catch a train or to win a race, must find some way of counteracting the immediate tremendous drafts upon his energy. Usually his "oxygen intake"—that is, the amount of air he is able to force into his lungs—rises steadily for two and a half minutes after the exercise begins. At the end of that time he has reached his breathing limit. His oxygen intake remains constant so long as he continues to run at the same speed.

In the meantime the lactic acid that is forming in the muscles passes from them into the blood and

*Dr. Hill's results were described by him recently in The Oliver-Sharpey Lectures before the Royal College of Physicians in London, published in *The Lancet*, vol. 207, pp. 307-310, 361-365, Aug. 16 and 23, 1924.



From photos copyright in 1887, by Eadweard Muybridge

ONE OF THE EARLIEST ATTEMPTS TO STUDY HUMAN MUSCLES

Years before the motion picture was invented Mr. Eadweard Muybridge, at the University of Pennsylvania, used electrically timed cameras to study the exact movements of human muscles during exercise. This is one of the remarkable series of photographs made in that research

From plates copyright in 1887, by Eadweard Muybridge

ANOTHER OF MUYBRIDGE'S FAMOUS SERIES OF MOTION STUDIES

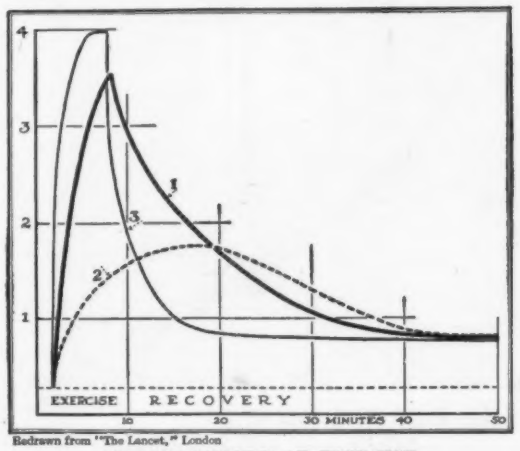
By series of timed photographs similar to those used for the study of the movements of athletes Mr. Muybridge succeeded in analyzing the movements of trained dancers, as well as in studying the movements, made by horses, lions, dogs and other animals. The cross lines in the background were used to measure each movement exactly

thence into other parts of the body. A peculiar thing may now happen. If the runner is not using all his muscles, those muscles which are not in active use may take up some of the lactic acid from the blood. When this acid absorbed by other muscles begins to be re-converted into glycogen it is possible, as Dr. Hill puts it, "to recover in one's arms from exercise taken in one's legs."

This means of relief, which may be of some advantage to a man who is using only his arm muscles or his leg muscles, is not available when the whole body is under exercise. In that case the amount of lactic acid in the body goes on increasing, causing a stiffening and weakening of the muscles, until the runner, rower, boxer, or whatever he may be, is completely exhausted. He is then compelled to rest. During rest oxygen is absorbed and the lactic acid is transformed into glycogen.

"Were it not for the fact that the body is able to obtain its energy in this way, by using its necessary oxygen afterwards," says Dr. Hill, "severe exercise would be impossible in man. We should never be able to run upstairs, or to run on the flat at more than eight or nine miles an hour. We can do so only because Nature has provided us with an arrangement, like an accumulator which can be run down at a very high rate, as in starting a car, and then must be recharged slowly afterwards."

Determination of the lactic acid make it possible to measure, not only the oxygen needed for a given type of exercise, but sometimes the rate at which such an exercise may be performed most economically. One investigator ascertained, for example, that the amount of oxygen used in climbing a certain number of stairs decreased for a time as the rate of speed increased, and then increased again. But this rule does not hold good of running. A running man's use of oxygen increases as his speed increases.



Redrawn from "The Lancet," London

THE CHEMISTRY OF EXERCISE

Curve one shows the accumulation and loss of lactic acid in muscle during and after exercise. Curve two shows the lactic acid found simultaneously in the blood. Curve three shows the intake of oxygen

Dr. Hill has tested these conclusions by tabulating the world's records for running different distances and has found that when these records are plotted on a chart a perfect curve results. For short distances the speed remains constant. As the distance lengthens, the speed drops swiftly. For very long distances the speed again becomes constant. "It would require almost a superhuman effort," says Dr. Hill, "to change one of the points by two percent."

The secret of this lies in two necessities which no athlete, no matter how powerful, can avoid. First, his muscles will not tolerate more than a certain amount of lactic acid. When he has reached this limit of toleration he must stop. This ability to resist the effects of lactic acid Dr. Hill calls the athlete's "capital." Second, the amount of oxygen which an athlete can take in while running is also limited by the capacity of his heart and lungs. This Dr. Hill calls his "income." The runner's "capital" and "income," taken together, constitute his resistance to fatigue. When both are gone he will be completely exhausted.

But there is another remarkable fact that comes to our rescue and makes possible much more violent exertions than would otherwise be within our reach. The speed at which lactic acid can be turned back into glycogen is "proportional roughly to the square of the concentration of lactic acid in the active muscle."

Let us see precisely what this means. If both the accumulation and the elimination of lactic acid were directly in proportion to the violence of the exercise ordinary walking would produce four times as much fatigue as a state of rest, and hard exercise sixteen times as much. As a matter of fact, owing to the law just stated, walking produces a concentration of lactic acid—in other words, a fatigue—only twice as great as that occurring in a state of rest, and violent exercise a concentration only four times as great. "It would have been very awkward," Dr. Hill points out, "had it been the other way around."

Recovery from exercise—the process of getting one's breath back and resting one's tired muscles—depends on the capacity of one's lungs and heart and upon the local circulation carrying blood to the muscles involved. Some of us can take in oxygen much more rapidly than others. In one experiment a subject of Dr. Hill's, breathing a special mixture of 50 percent oxygen, took in 5.9 litres a minute.

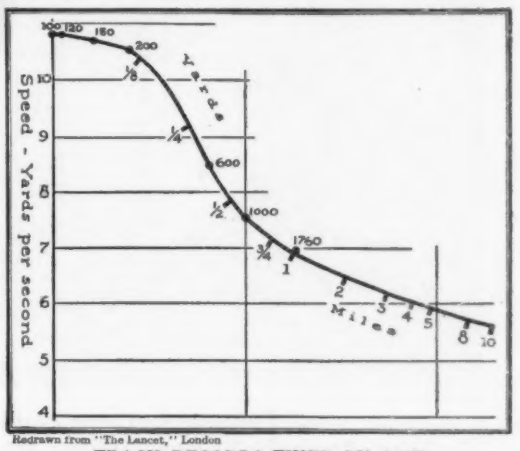
The meaning of these figures is best understood in terms of the amount of blood that had to be pumped to carry the oxygen through the body. This, it was estimated, amounted to 56 litres, or 12½ gallons a minute. "Compare these volumes," Dr. Hill suggests, "with the amount of water which a bath tap can pour out in a minute, even when turned full on. It is little wonder that the heart sometimes cannot stand the strain."

The exact amount of muscular energy which a person can expend before exhausting himself depends upon a great many factors, many of which can be expressed chemically. Indeed, it may *all* come down to lactic acid in the end. On your ability to utilize and eliminate this acid may depend not only your prowess as an athlete, but the energy which you are able to devote to your daily work.

It would not be carrying Dr. Hill's conclusions to too great an extreme to say that your life career may be fairly well gaged by your relations with lactic acid. Dynamos of human energy, like Theodore Roosevelt, must have been exceptionally well equipped with chemical mechanisms with which to overcome this fatigue-producing principle.

The human body can be understood best if it is looked upon as a pot of chemicals. Our commuter running for his train may be a married man, a father, a citizen, and a good deal besides.

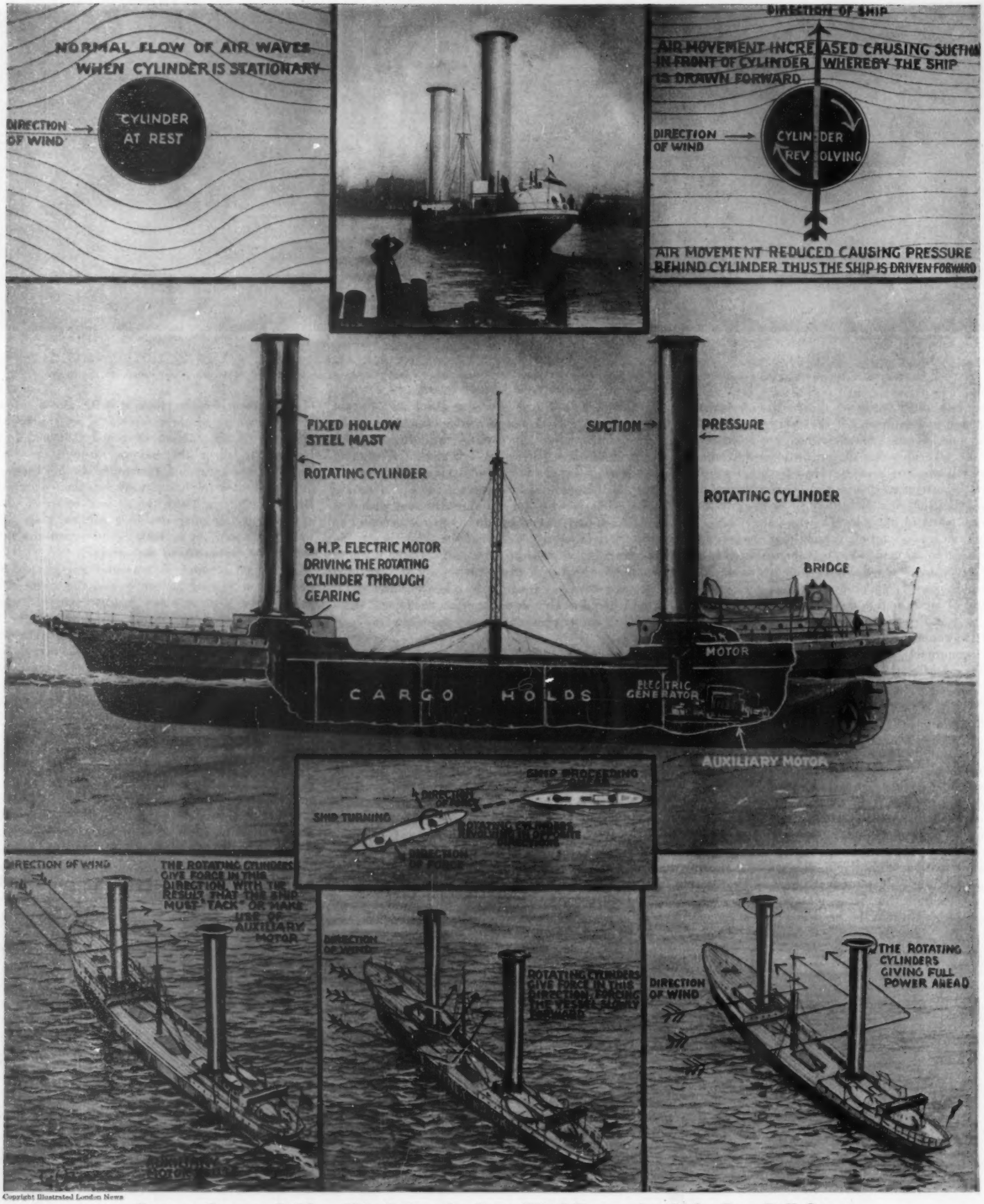
The scientist ignores these things. He considers the commuter, and all the rest of us, as chemical test tubes in which acids and alkalis, lactic acid, glycogen and oxygen contend for the mastery.



Redrawn from "The Lancet," London

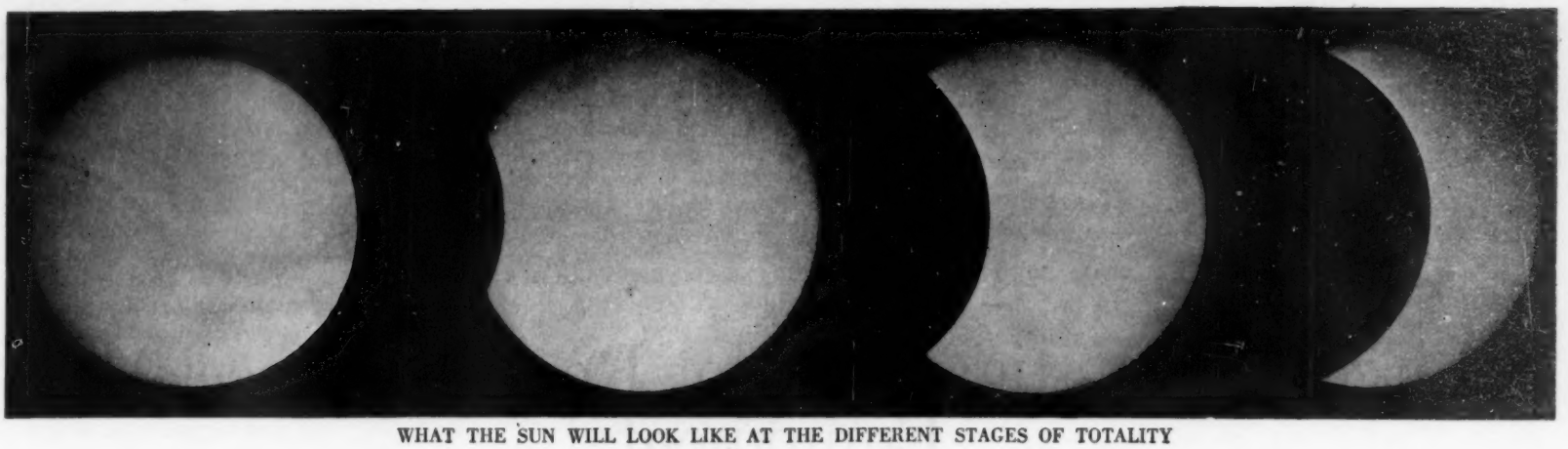
TRACK RECORDS FIXED BY ACID

This curve shows the track records of the world, arranged according to the distance run. This curve is determined, Dr. Hill believes, entirely by the chemical relations of the lactic acid, oxygen and glycogen in the muscles



Famous German Sail-less Ship Driven by Same Wind Forces that Make Base Ball Curve

In the new "rotor ship" invented by Herr Anton Flettner the force comes from wind eddies around the two revolving towers, each approximately 60 feet high and 10 feet in diameter. This force is the same as that which deflects a pitched base ball from a straight line into a curve; the secret in this case also, being a rotation imparted to the ball when it is pitched. The towers of the Flettner ship rotate at about 100 revolutions per minute. The importance of the new invention in marine transportation will depend on the efficiency attained in actual use at sea. As yet no facts are available. It is not claimed that the rotor ship extracts any more energy from the wind than does a set of sails but the rotors require fewer men to handle them.



WHAT THE SUN WILL LOOK LIKE AT THE DIFFERENT STAGES OF TOTALITY

Do Not Miss Seeing the Solar Eclipse

The American Astronomical Society and the Scientific American Ask Certain Public Cooperation, as Explained on the Following Pages. On This Page Professor Russell Tells You Something of What This Greatest of Natural Spectacles Will Be Like

By Professor Henry Norris Russell, Ph.D.

AS THE New Year approaches, the interest of every one, whether an astronomer or not, tends to focus upon the coming total eclipse of the sun. We spoke last month of the general circumstances which attend this remarkable event. This time we write especially for those readers who hope to be, on the morning of the 24th of January, within the wide belt, crossing New York and New England, within which the eclipse will be visible as a total one.

A word as to weather conditions. The records of the Weather Bureau show that the best chance of clear skies will be found near the ocean, where the chance is about fifty percent. For points farther west, the probability of favorable weather slowly but steadily decreases. Residents anywhere along the shadow-path are amply justified in making preparations, even if the chances of good weather are against them. Those who travel to see the eclipse will be wisest to take their stations east of the Hudson.

Here a word of warning to the inexperienced may be in order. Do not tire your eyes by looking too long or too often at the relatively uninteresting partial phases of the eclipse. Do not look directly at the sun at all unless you have some kind of "dark glass" through which to look.

Nothing is better for this purpose than a photographic plate or film which has been exposed to the light and then developed. One so dense and black that the sun is just visible through it when the plate is held close to the eyes is about right.

With the aid of such a dark glass the steadily growing nick in the upper right-hand edge of the sun will be worth watching as a prelude to the play.

By nine o'clock, when only a narrow crescent of the sun remains in sight, the country will take on a weird appearance. The light from the sun's edge is not merely fainter, but is different in color and quality. All the color values of the landscape become altered—usually in a most uncanny fashion.

The obscurity steadily grows. At two or three minutes before totality the moon's shadow comes into sight in the west, darkening all the sky and advancing with tremendous speed. On the present occasion, where the sun is low in the sky, the shadow will come almost directly downward out of space. The darkening of the western sky should be rapid and very striking.

This crowns the impression made by the strange coloring and the advancing gloom. No one who has seen it can doubt the ancient tales of battles stopped in their highest heat by an eclipse. It really seems as if the sun had gone out, even that the world is coming to an end.

But the precious seconds of totality are too few to spend in alarm. The moment that the darkness sets in all eyes must turn toward the vanished sun. In a few seconds one realizes that it is not by any means pitch dark, but much more like a moonlight night. Only a few of the brighter stars can be seen and there is no difficulty in finding one's way about. The sky is not black, but a deep slaty blue. In it hangs the disk of the moon, slaty blue like the sky, and around the moon's edge shines that wonderful fringe of light which the astronomer has named the *corona*—The Crown of The Sun—and which he is willing to travel far to observe for the few minutes during which the sun is totally eclipsed, because it is at this time alone that the corona can be seen.

On the inner coronal ring, close to the dark moon, one or more solar prominences may appear, as brilliant red wisps of light which look like flames blown into all sorts of shapes by the wind. They look small to the eye, but often they are tens and even hundreds of thousands of miles high, big enough to surround the earth completely if it were anywhere in the neighborhood. At the coming eclipse—this being a year of few sunspots—it is not probable that the prominences will be large. Possibly some may be visible through an opera glass.

All too soon the short totality—lasting hardly more than two minutes at the most—will come to an end: and now is the time to watch for things which are better left unlooked at as the sun goes into the shadow, lest the observer's eyes be dazzled. Just before the end of totality the inner corona brightens perceptibly, then something far brighter, shining with a white, steely light, appears. This is not the sun itself, but its hot lower atmosphere—as becomes clear a second or two later, when the sun's surface, incomparably more brilliant, bursts forth. The air fills with light, drowning out the outer corona at once and the inner corona after a minute or so. The great spectacle is over!

The amateur astronomer, while he will not willingly miss a single one of the things that the "man in the street" may see, will have his eyes open for more. He will have, of course, a good binocular, with which to see the details of the corona and of any prominences which may be present. If he is at all interested in the spectroscope, he may well bring with him one of the little "replica gratings" (celluloid casts from the costly originals), which are transparent and which enable the observer to see, at the same time, a source of light and, at one side, its spectrum.

With such a replica in front of one of the lenses of his field-glass, one may see the continuous spectrum of the corona, the bright lines due to the prominences, and if he looks sharp, the bright-line "flash spectrum" of the sun's lower atmosphere as it comes out.

But many amateurs and many persons not ordinarily interested in astronomy at all will want to do more than merely gaze. They will desire to make some observations which will have scientific value. Several things are open for them to do.

They may make observations on the audibility of radio signals, as has been arranged for the collaborators in the Scientific American's Eclipse Investigation described here. Or they may assist in locating the exact path of the eclipse, as is being arranged by the American Astronomical Society as described in the following article.

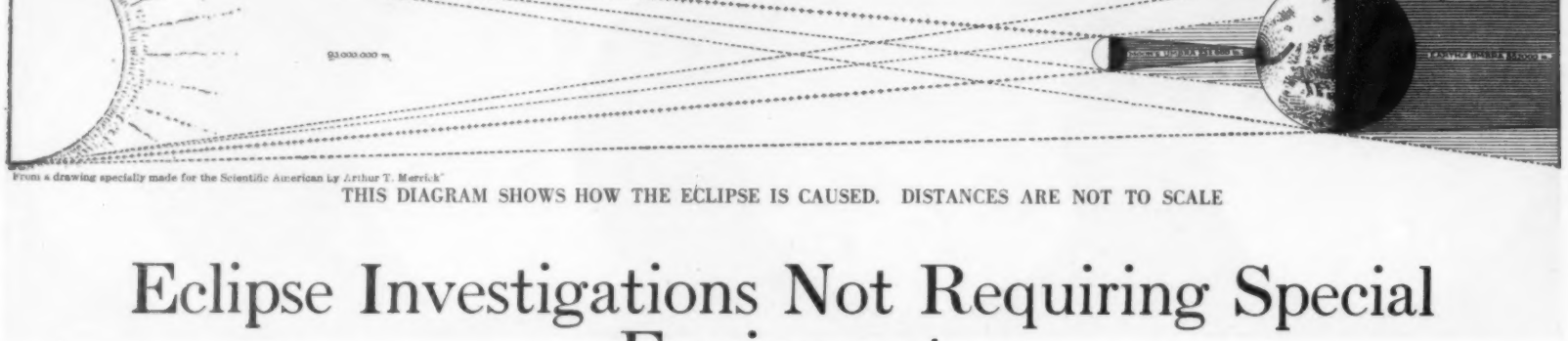
To Business Men
Close your offices and factories on the morning of January 24th. Let your employees help investigate this great natural marvel.

To Transportation Companies
Run through trains, special trains if necessary, to take the public to vantage points for observation.

To Scoutmasters and Boy Scouts
Organize lines of observers specially posted to measure the edge of the shadow path as described on page 15.

To Teachers and Scientific Men
Enroll your pupils and friends into groups to make the investigations described on the following pages.

To Everybody in the Eclipse Zone
Study these pages. Do something to help. Let us honor America by making this a record year in public help to science.



From a drawing specially made for the Scientific American by Arthur T. Merrick

THIS DIAGRAM SHOWS HOW THE ECLIPSE IS CAUSED. DISTANCES ARE NOT TO SCALE

Eclipse Investigations Not Requiring Special Equipment

From data furnished by Ernest W. Brown

Professor at Yale University and Chairman of the American Astronomical Society's Committee on Public Cooperation and Information

AT THE solar eclipse of January 24, 1925, the band of total darkness will cover a territory so much greater in population than any total eclipse of the past or the near future that the American Astronomical Society feels it to be a good opportunity to secure the cooperation of the public in obtaining certain observations. An account of what observers may see if the weather is clear has been given by Professor Russell in the preceding article. In the following paragraphs are instructions for carrying out several kinds of observations which can be made by anyone and which will be extremely useful for the progress of scientific astronomy.

There are four of these investigations. First is the photography of the corona or fringe of light around the fully eclipsed sun. Second is the determination of the amount of light received from the sky during the time of totality. Third is the investigation of the mysterious "shadow bands" which immediately precede and follow the period of totality. Fourth, and most important of all, is the exact determination of the edge of the shadow path on the surface of the earth.

Tables of the Moon

The especial importance of this marking of the shadow path is due to the fact that the astronomers cannot predict the exact place of the moon's shadow on the earth closer than about one mile, or the exact time of the eclipse to an accuracy of more than a few seconds.

Such predictions as can be made are prepared years in advance from tables which have been calculated and printed especially for the purpose of predicting the place of the moon in space at any time. These tables are based, in the main, on observations of the moon, running back many years into the past and taking into account, of course, what we believe to be the gravitational laws which control the relative motions of the sun, the moon and the earth.

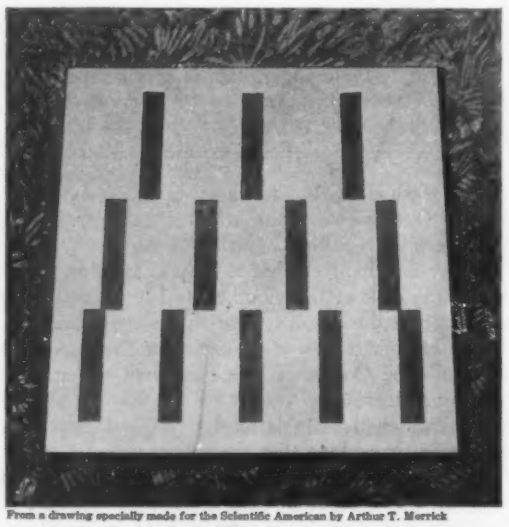
If we can determine for the coming eclipse the position of the edge of the shadow path on the earth to within a hundred feet or less and if we can determine simultaneously the exact times at which the total part of the eclipse begins and ends, astronomers hope to be able to use this improved data to discover whether any further correction is necessary in these important tables and to calculate exactly what this correction will need to be.

The determination of the exact time of the eclipse will be done best by trained observers working with the most accurate and expensive equipment. What the general scientific public can do—and do well—is to locate exactly the path of the shadow across the earth.

It is strongly urged that every person interested in science and who can by any means arrange to do so should station himself at some proper point (as is described in detail in the following paragraphs) and should make and report the necessary observations. It is by no means an overstatement to say that adequate public cooperation in this important investigation may furnish a better value for the moon's position at the time of the eclipse than could be obtained in any other known way.

The ideal thing would be to have thousands of individuals stationed about one hundred feet apart throughout two strips of country, each a few miles wide and covering the two edges of the calculated shadow path. If each of these thousands of observers reported his exact position on the earth's surface and whether or not the eclipse was absolutely total at that position, the data obtained would permit the calculation of the eclipse path with an accuracy much greater than any previously obtained.

So comprehensive a plan of observation as this is probably impracticable but a great deal of valuable data can be obtained if persons who happen to be near the calculated edges of the path on the morning of the eclipse will note down and report only two facts: *One*, exactly where the observer stood; *two*, was the eclipse total at that point or was it not?



From a drawing specially made for the Scientific American by Arthur T. Merrick

HOW TO OBSERVE THE SHADOW BANDS

A piece of beaver board painted with three sets of bands will serve for this observation, as described on page 15

The Scientific American has offered to collect and study such reports and to turn over the assembled data to the American Astronomical Society. A coupon for reporting observations will be found on page 61 of this issue. Similar coupons will be published in other magazines and in newspapers. Reports can be made, if desired, by letter or in any fashion, no coupon being necessary. They may be mailed to the Scientific American, 233 Broadway, New York City, or to the National Research Council, Washington, D. C., marked "Eclipse."

The calculated path of totality is shown approximately on the map printed in the November, 1924, issue of the Scientific American. A map on a larger scale has been issued by the United States Government as a part of a pamphlet entitled "Total Eclipse of the Sun, January 24, 1925," which pamphlet is procurable from the Superintendent of Documents, Washington, D. C., at a price of thirty cents in money or money order, payable in advance. Stamps are not accepted.

Where the Eclipse Occurs

The path of totality begins about 120 miles west of Duluth, Minnesota, where the sun rises already eclipsed. Eastward of this point the shadow passes over parts of the Great Lakes, practically covers the state of Connecticut, extends across the Atlantic Ocean and bends up to the northwest of Scotland, where it ends about sunset. The lower edge of the band of totality just covers Duluth, Minnesota; Menominee and Frankfort, Michigan; London, Ontario; Dunkirk, New York; Wilkes-Barre, Pennsylvania; and New York City north of Central Park. Inside the northern edge of the path are Manistique, Michigan; Toronto, Ontario; Auburn and Hudson, New York; and New Bedford, Massachusetts. A mile or two outside the path are Syracuse, New York; Springfield, Massachusetts, and Providence, Rhode Island.

Totality begins over Duluth at about one and one half minutes past eight o'clock, Central Standard Time, gradually getting later until it reaches Rhode Island where it begins about eleven minutes later or nearly thirteen minutes past nine, Eastern Standard Time. Except near the northern and southern boundaries of the shadow path, totality will last about two minutes. This time seems short enough, but the longest eclipse never lasts much more than eight minutes, and a good deal can be done even in two minutes if one is properly prepared. In the table on page 15 are given their approximate times and durations of totality for a few representative places along the shadow path.

In making these reports of totality or non-totality along the edge of the eclipse it is necessary to be extremely precise about the exact position of the observer on the map and also to be very sure about whether the eclipse was really total at that point or merely *almost* total.

To settle the last point there are four tests of totality all of which are set down as questions one to four in the coupon on page 61, and all of which should be applied by each observer, as many of the four questions being answered as possible.

As to the exact position of the observer the main thing to keep in mind is the necessity of locating the position of the observer by reference to some fixed and recognizable landmark, as, for example, a well-known crossroad corner, a railway junction, a public building or something of that sort. The distance from such landmarks should be given to the nearest hundred feet. In cities or towns the most convenient way to locate one's position is by reference to the nearest street corner, naming the streets.

What Boy Scouts Can Do

In some localities it may be possible for a number of persons, such as school science clubs, groups of boy scouts, etc., to combine together ahead of time and to arrange to post their members at set intervals along a north-and-south line crossing the probable edge of the shadow path. This will provide an almost perfect measure of the place where the shadow ends, for the position of the outermost observer to report totality will fix the edge of the path exactly.

The editors of the Scientific American will be glad to get in touch with scoutmasters, teachers or others who are willing to organize and supervise such posted lines of observers. They will send such persons detailed suggestions about how to proceed. Address the Editor, Scientific American, 233 Broadway, New York, N. Y.

Turning, now to the three other investigations which can be attempted, with advantage to science, by persons who find themselves within the path of totality, the main one is the photography of the corona. The weather may be cloudy at all the places where the professional astronomers are situated and clear at some spots where there is no observatory. What is needed is *some* record of the shape of the corona.

A photograph made with an ordinary camera is better than nothing.

Photographing the Corona

At least two sets of exposures should be made. One of them should be short, say half a second to five seconds, so as to get the inner corona close to the sun. The other set of exposures should be from five to twenty seconds each, to get the outer and weaker fringe of the corona. There will be time for more than one of the first set if the plates are changed rapidly by rehearsing beforehand. A photographer who has one of the old portrait lenses such as a Petzval doublet, with focal length of twenty to thirty inches, will find it useful to dust it off and rig it up in a camera. This gives a larger scale than the more modern portrait lenses. If the observer has a telephoto lens it may also be well used.

The times of exposure should be based on the known performance of the camera on the basis that an exposure of about a quarter of a second will give an image of the inner corona with an ordinary camera. For the long exposures the sun will trail to some extent, but this will not matter as the outer part of the corona is not very definite and the trailing will be very minute.

Remember that *you may get the only picture secured of the eclipse*, especially if you are situated on one of the western shores of the Great Lakes where there are no smoke clouds or buildings to interfere with the view provided that the sun rises clear of clouds. The following particulars should be noted and reported: (1) the lens used, (2) its focal length, (3) the make of plate or film, (4) the exposure used for each picture. If you are not willing to part with the negative itself the committee would like to have two good prints from each negative. As before, reports or photographs may be sent either to the Scientific American or to the National Research Council.

The next phenomenon that may be observed is that of the so-called shadow bands. This curious appearance is often seen just before the moon completely covers the sun.

Looking at the white side of a house or onto a big white sheet spread over the ground one may see little dark and bright wavy bands traveling across the surface. The bands are usually about a foot apart and some inches wide, although not very clearly defined. No one seems to be quite certain what causes them and they are not seen at every eclipse. It is generally believed that they are caused by the motions of the atmosphere but they are seen for such a short time when they are visible that it is difficult to observe them properly and still more difficult to make good measurements of their width or of their distance apart.

The measurements most required are their direction (from the north), their distance apart, their breadth and the rapidity of their motion. These can be obtained by laying a sheet on the ground and holding a stick in each hand ready to lay down on consecutive bands as they pass, estimating their breadth as you do so and counting the number that pass in say, five seconds.

Another method is to obtain a piece of beaver board about five feet square covered with white paper and divided into three sections marked with three sets of dark bands. Well-watered ink put on with a brush will serve for these bands. The bands should be about three inches broad; the upper set, say twelve inches apart, the next, ten inches, and the third, eight inches, as shown in the diagram.

As soon as the shadow bands appear, twist this board around so that the shadow bands are parallel to the dark bands on the board. Then note which of the three sets of bands painted on the board gives the greatest changes of light and darkness as the shadow bands pass. The width of the shadow bands can be estimated at the same time.

Time Table for the Eclipse

This table gives the approximate time of the beginning of totality as calculated for a number of cities in and near the shadow.

Important Note

All these times are given in Eastern Standard Time. For Duluth, Iron Mountain and other places that use Central Standard Time, the local time for the beginning of the eclipse will be one hour earlier.

	Beginning of Totality	*Duration of Totality, in Minutes*
Duluth, Minn.	*9:02 A. M.*	*0.4*
Iron Mountain, Mich.	*9:03 A. M.*	*1.7*
Bellaire, Mich.	*9:04 A. M.*	*1.9*
Stratford, Canada	*9:05 A. M.*	*1.8*
Buffalo, N. Y.	*9:06 A. M.*	*1.8*
Warsaw, N. Y.	*9:07 A. M.*	*1.9*
Hornell, N. Y.	*9:08 A. M.*	*1.4*
Ithaca, N. Y.	*9:09 A. M.*	*1.8*
New York City (northern part)	*9:10 A. M.*	*.5*
Poughkeepsie, N. Y.	*9:11 A. M.*	*1.9*
New Haven, Conn.	*9:12 A. M.*	*2.0*
Montauk Point, L. I.	*9:12 A. M.*	*2.0*

Watch the Shadow Bands

In sending in the results give (1) the observing method used, (2) the direction of the shadow bands, (3) the distance apart, (4) the width, (5) the approximate length of time during which the bands were visible, (6) the number of seconds before or after totality that they became visible, (7) the number of the shadow bands that crossed a fixed mark on your sheet in five seconds, and (8) whether the shadow bands were wavy or straight.

For the fourth possible observation, the diffused light of the sky during totality, a rough method is to give the size of print which can be read. What buildings can be seen as compared with those visible in the light of the full moon? Or you can use a Watkins or Wynne exposure meter, exposing strips of sensitive paper, for, say, ten seconds, twenty seconds, thirty seconds and forty seconds during totality and later another strip for similar periods in moonlight when the moon is full. A similar method can be used with an ordinary photographic plate exposed during the eclipse and afterwards to moonlight, the two being developed together later on.

The light intensity of the corona can be estimated similarly, from photographs taken with an ordinary camera. Several exposures of different length, ranging from half a second to five seconds, can be taken on the same plate by moving the camera slightly between exposures. A plate from the same box should be exposed in the same camera for similar periods to the full moon, the two being developed together.

Rehearse Your Work in Advance

You may be able also to devise means of your own for obtaining both the amount of light given by the corona and the diffused light of the sky during totality. The point is to get some means of comparing these light intensities with some standard which can be reproduced elsewhere, as, for example, the light of the full moon or of the half-moon. Standard lights are available, of course, to those who are fortunate enough to have laboratory equipment.

But the main thing is to decide *in advance* just what you intend to observe during the eclipse. If possible, associate a friend or two with you in the observation. Study out together just what you will have to do. *Rehearse it several times with a companion standing nearby and counting seconds with a watch.* This will tell you whether you can compress all that you plan to do into the few seconds that you will have available during the moments of totality.

If the operations that you propose to attempt involve anything at all complicated it is well to test your plans by repeated rehearsal at the correct time of the morning on several days ahead of the eclipse, with the sun in the approximate position that it will occupy in the sky on that fateful morning. This may disclose some precaution that needs to be taken and that you may overlook otherwise. And if you need information, instruction or help of any kind in planning the observations that you decide to attempt, write to the Editor of the Scientific American and ask for what you want. Every possible effort will be made to help you.

Our Own Radio Investigation

By the Eclipse Editor of the Scientific American

IN THE November, 1924, issue of the Scientific American we announced the organization of a corps of collaborators to help us investigate the exact effects of the eclipse on radio transmission.

Many radio enthusiasts have registered with us for this work. If you are among them you have doubtless received already the instructions covering what you are asked to do. If not you will receive them shortly. If you are not already registered, if you have a radio receiver and if you want to help in this phase of the eclipse investigation send in your name to us immediately, together with the information asked for in the box printed on this page. It is still not too late to join the crowd in this interesting work.

What scientific information is now available indicates a more or less profound influence of solar eclipses on radio transmission, especially at the usual broadcasting wavelengths. It is well known that the daily alternation of sunlight and darkness affects radio transmission. The effect of an eclipse may be merely an instance of this. But on the other hand there is some information suggesting other effects; effects due, perhaps, to the temporary stoppage by the moon of streams of electrons or of other electrified particles shot out toward us from the sun.

During the total eclipse of the sun visible in California in 1923 the few radio listeners who were on the air in that part of the world noticed some peculiar fadings and strengthenings of signal strength. It was not possible to explain these adequately because of the small number of reports obtained. During the coming eclipse it is hoped to obtain several thousand such reports from listeners. The data sent in will be studied by a committee of prominent radio engineers under the supervision of the Scientific American.

Mysteries of Radio Transmission

It is confidently expected that the facts obtained will help to elucidate some of the many features of radio transmission that remain mysterious.

Plans are being perfected, of course, for a number of comprehensive scientific studies of radio conditions during the eclipse. Automatic recorders will be stationed at several points in the shadow path and will be used to obtain complete records of the signal strength of selected broadcasting stations before, during and after the period of totality. These investigations were initiated by, and are in charge of Mr. Greenleaf W. Pickard.

Radio amateurs who have transmitting or experimental licenses are being organized by the American Radio Relay League into several groups each of which will undertake specific investigations, all carefully studied and rehearsed in advance.

The Scientific American is cooperating in every possible way with all these investigations. We will assist in collecting and analyzing the results. We hope to be one of the agencies for the presentation of the work when it is ready for publication. But there is one duty in these radio eclipse investigations which the Scientific American has accepted as especially its own. This is the organization of what can be accomplished by the great body of American radio listeners.

Listeners who cooperate with us in this will need no apparatus except a radio receiving set. They will need no time except a total of about forty minutes before, during and after the period of totality. Full instructions will be supplied to all who register for the tests but when these paragraphs are being written it is too long ahead to set down all of these instructions here. Our plans are necessarily incomplete. It is possible, however, to outline the main features of what we propose to do.

A limited number of broadcasting stations will be selected; probably two within the shadow path, two or three north of the shadow path and two or three south of the shadow path. These stations have not yet been selected finally, it being necessary to make this selection so that there will be no interference with the stations that are to be used in Mr. Pickard's tests with automatic recorders or with stations in use for other scientific purposes. Many broadcasting stations have already offered their full cooperation in any plans that may be arranged.

How to Register for the Tests

Many enrolments have come in for the radio investigation of the eclipse, as announced on page 312 of the SCIENTIFIC AMERICAN *for November. Others are welcome.*

If you are willing to listen to special signals which will be broadcast for about thirty minutes during the eclipse and to report what you hear, you may assist us to determine the mysterious effects of the sun on radio transmission.

Read this page. Write us and enroll. Be sure to send us ALL of the following information:

1. *Your name and mail address.*
2. *What is the make and design of your radio receiver?*
3. *What kind and size of antenna do you use?*
4. *Do you use storage batteries or dry cells?*
5. *Are you located in open country or in town?*
6. *How long have you been a radio fan?*
7. *If you have an amateur license will you be willing to send signals if we ask you to, instead of listening?*

Address:

The Eclipse Editor,
SCIENTIFIC AMERICAN,
233 Broadway, New York, N. Y.

Full instructions will be sent you later and will be printed in the SCIENTIFIC AMERICAN *for February, 1925.*

To prevent interference all broadcasting stations not actually in use for tests will be urged to keep silent during the hours of the eclipse. All transmitting amateurs will also be asked to keep off the ether unless specifically designated for transmitting duty by the American Radio Relay League or other cooperating authority.

The particular six or eight stations having been selected for these tests, each cooperating radio listener will be instructed to tune to a specific one of these stations about twenty or thirty minutes before the time of totality. Some listeners south of the path of totality will be asked to tune in a station north of the path; other listeners to a station south of the path; still others a station within the shadow band itself. Listeners located north of the path or within the path will be divided in the same way. Each listener will be given two or more alternative stations in case he is unable to hear the one especially designated for him to listen to.

Beginning about an hour before the time of totality the selected stations will broadcast music and speech, freely interspersed with the call letters of the station, in order to facilitate this preliminary tuning-in.

Having tuned in on the particular station which he is asked to listen to and having made sure that his receiver is in perfect adjustment, the cooperating listener has nothing more to do until about fifteen minutes before the time of totality. At that time each of the broadcasting stations will begin to broadcast spoken words consisting of special copy, typewritten in advance, and read off very slowly into the microphone. The broadcasting of this spoken copy will be continued for about thirty minutes; that is, until about fifteen minutes after totality is over.

Listeners will be asked merely to listen to what is being read from the particular broadcasting station to which they are assigned and to report to us *any changes in intensity that they notice,* together with the precise word in the copy at which word they notice the signals to fade or to become stronger.

Checking Time by Words

This recording of the word of the set copy at which a change occurs will give us our time check. At each broadcasting station, in addition to the person who reads the copy into the microphone, there will be another person, also having before him a typewritten copy of what is being read. This person will be able to hear the time ticks of an accurate chronometer. At the instant of the beginning of each second of time he will mark on his copy of the manuscript the exact word which is being read at that second.

In this way a report, for example, that fading occurred at some definite word in the received material can be translated into a statement that fading occurred at some precise time. This can then be checked back to the position of the eclipse shadow at that particular instant.

Undoubtedly the best way for a listener to make a record such as this is to have a stenographer beside him and to dictate to this stenographer, word by word, the material that he hears over the ether, together with any comment that he can make as to changes in intensity. If, then, the received speech fades out altogether at a certain word or returns at another word, the stenographic transcript will show this precisely. The copy will be read off from the broadcast stations slowly enough to make such a stenographic record entirely practicable.

Investigation Is Simple

However, the availability of a stenographer is by no means a necessity for participation in the tests. Any listener can set down for himself on a pad of paper all the data that he needs to send in for a good and useful report. Instructions about this will be communicated in full detail to the cooperating listeners who have registered with us.

It is hoped, of course, that listeners who are able to do so will make records, also, of the occurrence of static or of any other feature of radio transmission which may have possible meaning. But the chief object to be attempted in so widespread an investigation as this must be kept simple and we have decided to make it merely the recording of changes of intensity in the received program, as described above.

The essence of such investigations as these is cooperation. It is strongly urged that anyone intending to attempt radio investigations, of whatsoever character, during the eclipse get in touch with the American Radio Relay League, with Mr. Pickard, or with the Scientific American, and make sure that what he intends to do will not cause interference to some other investigation that is already planned or in progress.

Mountains Made to Order

Glass Foregrounds Now Used in Hollywood Studios Instead of Expensive and Tiresome Trips to Strange Locations

By Paul D. Hugon

Production Manager for Associated Arts Corporation at F. B. O. Studios, Hollywood

MOTION picture production is constantly confronted with a fight between higher costs of production and the demand for more reasonable film rentals from the theatre owners. Year by year new devices are tried to equalize the outgo with the income.

The chief problem of production is how to complete a film in the shortest possible time.

Long ago, in the immense studios of Hollywood, with almost unlimited equipment, and with facilities of which the world in general little dreams in the way of furniture, decorations, lights, and human skill, it became possible to "crank" or "shoot" steadily, day after day, without ever having to wait for a set.

Yet there was one troublesome and costly source of delays. Many a scene required scenery which could only be found abroad, or a long way from headquarters; or scenic effects totally unachievable by ordinary photographic means. For instance, the interior of a cathedral, or the towers of a castle, or the placing of a house among high mountains.

Double exposure was first resorted to, in order to make these scenes. By cutting out a mat or mask the shape of the existing scenes, making one exposure, and rewinding the film for a second exposure from a painting or a miniature, it was easy to secure the desired effect. However, if this was done without considerable skill, the line between tne two exposures was very apt to show.

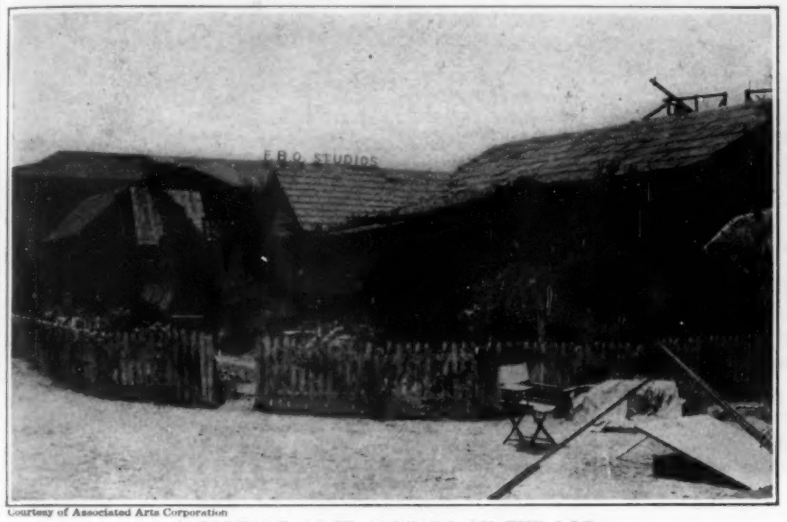
Eventually it struck someone to do it on glass. This is the method now used, and it has proved as effective as it is economical.

A large sheet of plate glass, absolutely perfect throughout and free from iridescence, about six feet wide by four feet high, more or less, is mounted in a wooden frame and fixed rigidly in place, in front of the set which requires to be completed. A few feet back of the glass the camera tripod is erected in rigid position, and through a finder placed exactly where the lens will be, or through the camera itself, the glass is lined up with the set.

Then the artist paints his upper part.

The result of this method has been seen on the screen for several months, although it has mystified many an observer. It is true that bigger and bigger sets are being built; but it is also true that many of the biggest sets shown, and all those in which a ceiling is shown in an interior of great magnitude, are the product of the glass painter's skill.

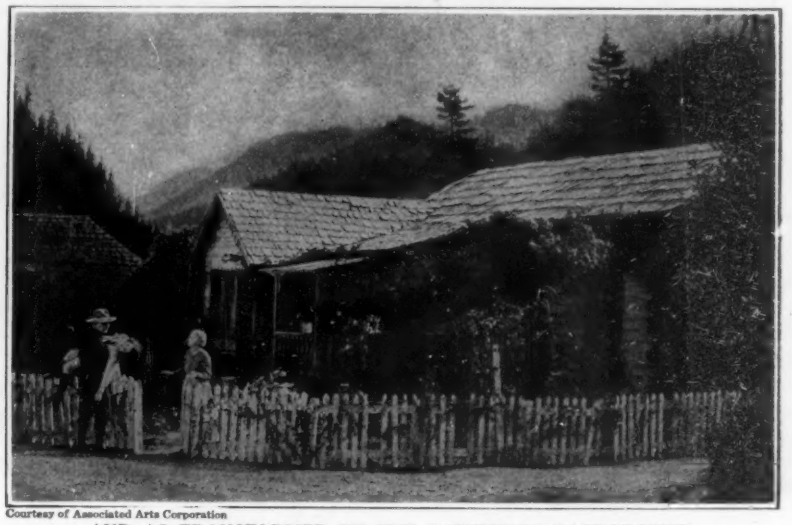
To prevent detection, the painter stays with the set while the shooting goes on, and, if it is an exterior, changes his lights to agree with the natural light that falls on the real object below. Thus a certain set, built out of doors, will be designed for use by morning light, and the glass will have every detail in it showing the light from the same quarter. If the scene takes too long, and afternoon arrives, changing the direction of the light, the artist sets to work and reverses his shadows.



Courtesy of Associated Arts Corporation

A COTTAGE AS IT APPEARS ON THE LOT—

This is the same cottage as the one in the other illustration. Note the hard sky background, which was unsuitable for the picture "On the Stroke of Three," a story of New England



Courtesy of Associated Arts Corporation

AND AS TRANSFORMED BY THE PAINTED-IN BACKGROUND

The sky, trees and mountains which appear in this photograph are painted on glass placed in front of the camera. This process creates the illusion of real scenery

Courtesy of Associated Arts Corporation

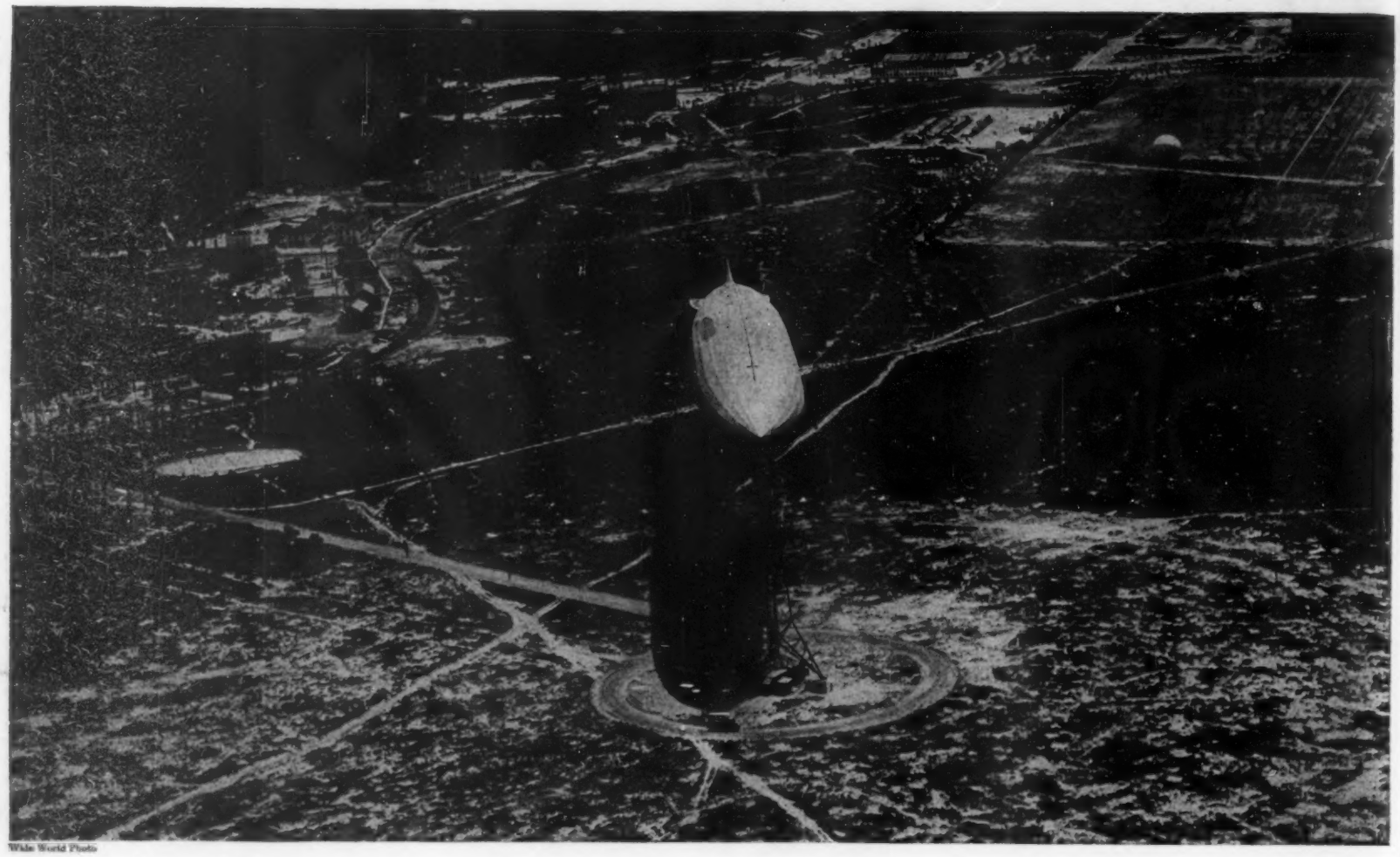
ARTIST PAINTING A GLASS BACKGROUND

Although it will appear in the film as a background, it is really photographed as a foreground, the scene itself being shot through the clear part of the plate glass

Courtesy of Associated Arts Corporation

GETTING READY TO "SHOOT"

At the left, behind a set of black flats and black curtains, so that the camera and lens do not appear as reflections, the camera is shown in position for shooting



Wide World Photo

Can Huge Dirigibles Supplant Our Ocean Liners?

The First of Three Articles on the Possibilities of the Giant Rigid Dirigible

By Alexander Klemin

Associate Professor of Aeronautics, New York University

THE record of the dirigible up to the present time has been one of contrasting success and disaster. Everyone remembers the splendid flight of the British *R-34* across the Atlantic, and back —3,600 miles in 108 hours. In November, 1917, the German Zeppelin *L-59* made a wonderful flight from Southern Bulgaria across Asia Minor, the Mediterranean, and the Sahara to German East Africa to relieve some beleaguered Colonial troops. The *L-59* failed in this undertaking, but it managed to carry nine tons of ammunition and four tons of medical supplies, and to return safely after a non-stop flight of 4,225 miles. In September, 1923, the *Dixmude* flew from the south of France over the Sahara and back and covered 4,400 miles in a non-stop flight of 105 hours. In October, 1924, the naval airship *Shenandoah* successfully completed her 9,000-mile transcontinental flight, and the *ZR-3* completed her history-making transatlantic flight from Friedrichshafen, Germany, to Lakehurst, New Jersey, a distance of 5,006 miles in the record time of 81 hours and 17 minutes. This is the longest non-stop flight to date. And these are but the high spots of achievement in military and naval operations.

We have records also of some successful experiments in commercial operations. Thus, in 1910, Count Zeppelin organized the Deutsche Luftschiffahrt Gesellschaft, and until the beginning of the war, four small ships of not more than 700,000 cubic feet capacity maintained regular service between Hamburg, Berlin and Friedrichshafen on Lake Constance. These ships made 1,588 flights, flew 110,000 miles and carried 34,228 passengers without a single injury to either passengers or crew!

Not a Single Accident

In 1918, after the war, the Germans again organized a regular passenger service between Berlin and Friedrichshafen, with two small ships the *Bodensee* and *Nordstern*. These ships were thrown together in five months, and in building them many parts left over from wartime Zeppelins were utilized. Yet during the summer of 1919 they maintained a perfect schedule between Friedrichshafen and Berlin, charging only 400 marks—a mark at that time still being worth real money—a passenger and thirty pounds baggage, for a journey of 375 miles. The service was finally stopped by the Inter-Allied Commission; but while it ran, thousands of passengers were carried without a single accident.

As an offset to these achievements, what a terrible trail of disaster marks the development of the rigid airship. Among German ships actually put in commission, thirty-three were dismantled as obsolete or worn out; fourteen were turned over to the Allies or deliberately wrecked; thirty-three were shot down during the war; sixteen were wrecked in storms or bad landings; four were destroyed while being handled on the ground and seventeen were destroyed by fire in their sheds. The Zeppelins proved highly vulnerable to attack. From a military standpoint they scarcely justified themselves. But what is more disquieting is the large number of accidents incurred with ships not actually engaged in fighting operations. The wrecks were perhaps unduly high in number; owing to exigencies of war. The crews were often hastily trained and meteorological considerations were frequently disregarded.

But initial disasters have never checked a new method of transportation. Man has always overcome the difficulties and dangers of his mechanisms, whenever there was a real advantage to attain. Every airship disaster has taught us some lesson which makes the repetition of a similar disaster unlikely and brings real safety closer.

Those who have actually flown in dirigibles have an extraordinary confidence in this type of craft. Even a passenger on his first flight has a great feeling of security, much more so than in the most ladylike hop over an airdrome in an airplane.

In the case of the airplane, pilot and passenger alike feel that through engine trouble they may be compelled to land at any moment. In cross-country flying, in particular, the airplane pilot must always keep in mind the finding of a suitable place to land in an emergency. The airship has a great advantage

over the airplane in the fact that engine breakdown is rarely to be feared, since it is scarcely conceivable that all its engines should cease to function simultaneously. And the lifting capacity of the airship is so much greater than that of the airplane that the engines can be very much heavier for a given horsepower than airplane engines, and therefore more reliable.

On the record non-stop flight of the *Dixmude,* not one of the six Maybach engines was stopped for more than two hours at any one time, and one of them ran continuously for the entire voyage. True, an airship may be blown so far out of her course as to have insufficient fuel to reach port, and an airship without motive power, blown about like a free balloon, is a very uncomfortable vehicle. Yet it is better to have the ability to float in the air for days when needs be, than to be compelled to land at a few minutes' or even seconds' notice as in the case of the airplane.

An Airship Runs Wild

Does the strength of the airship justify as much confidence as does the reliability of the power-plant? Dirigible enthusiasts claim that once in the air, the airship becomes part of the atmosphere, and that no matter what the strength of the wind, the airship floats with the wind with no more strain than if she were floating on a calm summer day above her flying field. This is true when the wind is steady, both in direction and in intensity. But if the wind varies violently, the airship must be prepared to stand enormous stresses. To realize this, it is only necessary to imagine what happens when the wind suddenly veers and strikes the great lateral area of the ship with great local violence.

Unfortunately the dynamic loads thus applied to airships are not known with any great degree of accuracy, and the complexity of the structure is such that engineers are not yet quite certain just how to make their strength calculations. Even the Germans did not seem to know how to calculate the strength of their Zeppelins. But they had vast experience and were able to draw up satisfactory empirical rules for the dimensioning of various structural parts. Although during the war the Germans built in a hurry, turning out ship after ship to meet their military needs, they did not lose a single ship through structural failure in the air.

The British, when they built the ill-fated *R-38* for the American Navy, did not have the same wide experience. They also made incomplete calculations neglecting air forces and taking only weight and gas lift into consideration. The ship was undoubtedly too weak amidships and collapsed under ordinary maneuvering over the River Humber.

When our Navy undertook to build the *Shenandoah,* its designers profited by this lesson. They calculated every part painstakingly and carried out a wonderful optical stress analysis, one of the most beautiful applications of optics known to science.

This painstaking work of the Navy has been fully justified. The "Wild Night of the *Shenandoah,*" so graphically described in the Scientific American, was a remarkable proof of the strength of the ship. Torn from her mooring mast in a gale of seventy-five miles an hour, with two forward gas bags ripped open, the rear vertical fin wrecked and the rudder hampered in its control, the *Shenandoah* survived both the tremendous initial shock, the unbalance of load due to the loss of gas in the two forward bags, and all the subsequent buffeting of a violent and erratic gale. The accident was a better and more convincing strength test than any that could be devised in the laboratory, and in the minds of technicians, the experience of the *Shenandoah* proved conclusively that in skilled and careful hands the strength of a rigid airship is now adequate to meet any air load that might be imposed on it.

The accident also demonstrated the tremendous reserve buoyancy of the modern airship and the wonderful control now available. The *Shenandoah* was in complete control less than five minutes after pulling loose, and was able to circumnavigate the storm and return to Lakehurst early the next morning. Yet strange to say a dirigible hull is aerodynamically unstable. If blown slightly off the line of flight, whether sideways or up or down, it tends to go further from the neutral position. But the horizontal and vertical fins are now so skilfully disposed, the rudder and elevators are so delicately balanced both as regards their weight and in consideration of the aerodynamic forces on them, that a man standing in the control car can spin the elevators some 500 feet away with ease. Without any motor to assist him he can control the ship in the most violent gale.

An airship can outride almost any gale when in the air or when at the mooring mast. But landing presents many difficulties. A great many devices have been proposed or tried, such as docking rails and wind screens. For the uncomfortable interval between the time the ship approaches the ground and the moment when the mechanical devices take charge, buffer bags under each car give a useful cushioning effect, and handling frames are provided for large ships, where the cars do not give sufficient hold, to furnish grips for a large number of men. The fact remains, however, that without a mooring mast, landing may require the services of 300 to 400 men thoroughly drilled in their duties.

Large Crews for Landing

To replace these men by mechanical contrivances is a difficult problem in mechanical engineering. The British have tried tractors with this end in view, towing the ship by its fore guys. The scheme has a difficulty, however, due to the severe shocks transmitted to the structure by the tractors riding over bumps on the ground, as well as the inability of the tractor to maneuver quickly. Perhaps some other more ingenious and satisfactory method of making a manless landing will be forthcoming.

If an airship is blown far off its course, and if its fuel has run out so that it is flying as a free balloon, the difficulties and dangers of landing become even greater. There is no dynamic lift (due to the motors) to help counteract a sudden loss of buoyancy; no extraneous aid to prevent the airship dashing violently to the ground; nothing to resist a sideways drift and crushing. A heavy guide rope may help over land since it is a species of recoverable ballast. At sea, a sea anchor may be of considerable assistance.

Forced landings being so dangerous there is no doubt that precautions akin to those found on every steamship should be provided in the shape of parachutes and light collapsible boats. But it is far

A Portent or a Dream?

If you had the opportunity to go to London in an airship, would you take a risk and go?

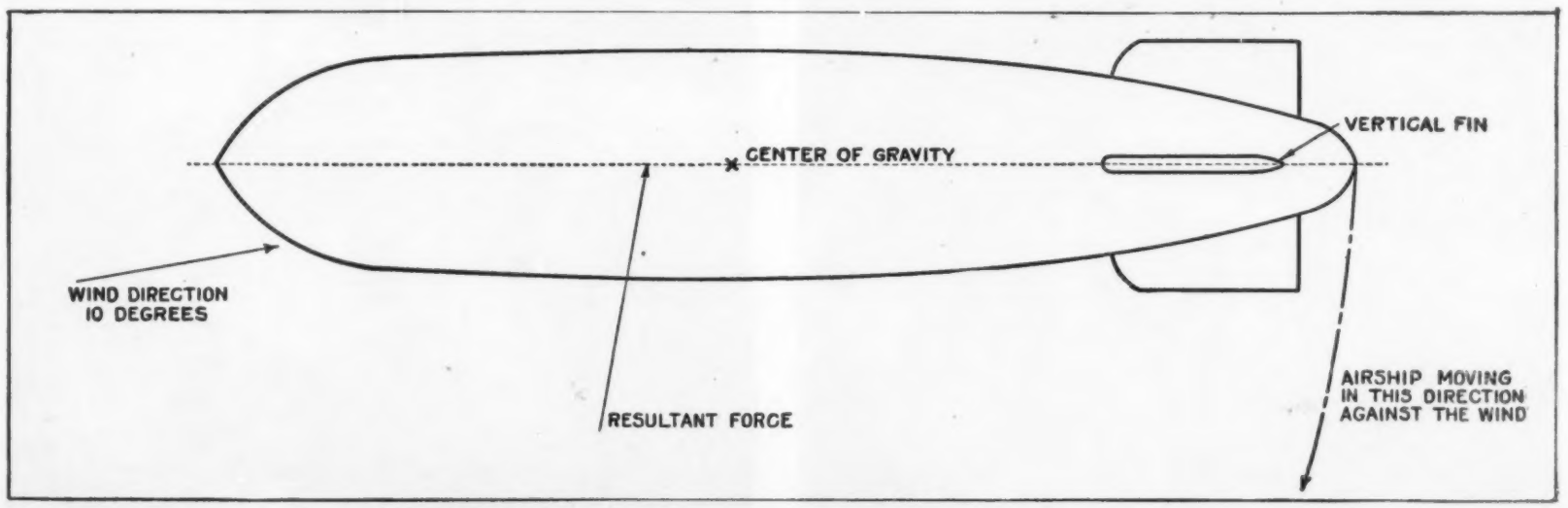
How much of a risk would you be taking?

Does the transatlantic voyage of the ZR-3 last October portend regular transportation of mails and passengers between Europe and the United States in less than two days, or, are these great gas-filled bubbles of aluminum too uncertain, too dangerous, too much the sport of storm and accident to take their place among man's useful servants?

Was the vision of the silver monster floating over New York City a portent of our future airfleets?

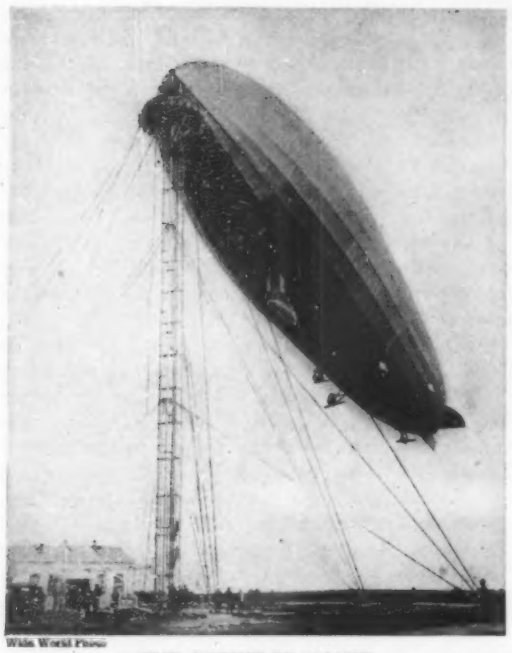
Or was it the last senseless dream of the few crack-brained inventors who have kept on believing that Count Zeppelin was not a fool?

Read these articles by Professor Klemin and you will know what you ought to think about these questions.



THIS DIAGRAM SHOWS WHY AIRSHIPS TEND TO SWING SIDEWISE IN THE WIND

Because of the shape of the ship the resultant force of a wind, slightly inclined to the axis of the ship, is applied forward of the center of gravity and swings the stern of the ship against the wind. This is partly counteracted by the vertical fin



Wide World Photo

THE TETHERED GIANT

The Shenandoah *moored to her mast at Fort Worth, Texas, a stop-over on her transcontinental flight from Lakehurst to the Pacific Coast and back*

more important that any airship operating on regular service or on commercial duty should be supported by a large number of prepared bases, without which disaster is sure to be incurred sooner or later.

The destruction of the *Dixmude* is a sad illustration of this point. The commander of the *Dixmude* still had some fuel on the last days of the trip, but insufficient power to enable him to reach a base. Evidently he thought a forced landing at an unprepared spot too dangerous and staved it off as long as he could with the disastrous results that we know.

Getting the airship in and out of its hangar is just as troublesome as making a safe landing and has been the cause of frequent accidents.

The British at one time were keenly interested in giant wind screens which lessened considerably the velocity of the side wind. But in strong winds the air thus forced out of its path descends toward the ground as soon as it can and a bad down current on an airship is as dangerous as a side wind.

The Germans never favored screens but used handling trolleys. In each hangar sets of rails were laid down extending to a distance of about a thousand feet. Wheels were fitted inside two vertical rails, which withstood the lifting and upsetting forces. Other wheels were made to run on a horizontal rail to take the side thrust. The ship was landed as near as possible to the end of the rails, was walked up to them, and was fastened at the bow by rope tackles running to the trolley wheels. Then the ship was moved along the track until the stern could be secured in a similar manner.

There still remained head-on or rear-on winds to take care of. Here reversing propellers were employed, which greatly facilitated the work of the landing party, provided the reversing mechanism were skilfully handled by the pilot and engineers still aboard the ship. The reversing gears, however, were cumbersome, heavy and noisy. We now owe to German designers a new device, which may prove of value not only in handling the dirigible but in many other fields of automotive transportation: the reversible gasoline engine. In the *ZR-3* built for the United States Navy in the great Zeppelin plant at Friedrichshafen, the great 400-horsepower Maybach engines will turn as readily in one direction as in the other. The ignition apparatus is arranged to work in either direction without alteration; the circulating water pump delivers equal volumes of water in both directions; and reversal is accomplished with wonderful simplicity by sliding the cam-shaft and thus reversing the valve-timing.

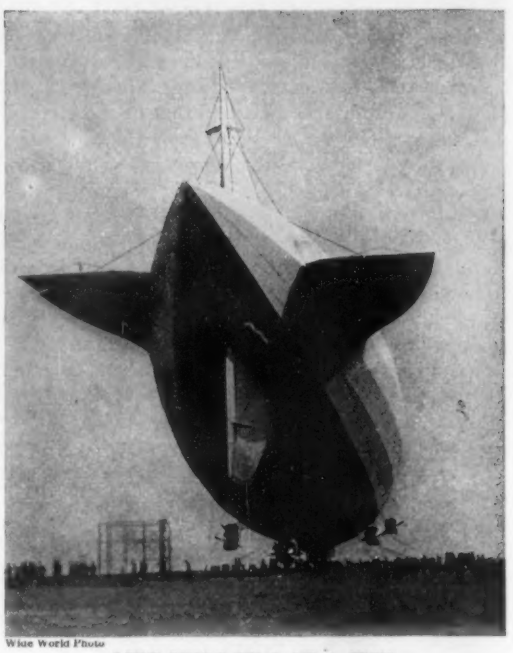
A Shed 1,000 Feet Long

Even with handling trolleys and reversible propellers the Germans found that they could not get their airships in or out of hangars, with side winds blowing at more than fifteen miles an hour. They achieved somewhat better results with revolving and floating sheds, which could always be headed into the wind. But what an engineering feat it would be to build either a revolving or a floating shed to house a dirigible 1000 feet long!

None of these methods achieved completely the object of being able to shelter or release an airship in strong winds nor did they remove the necessity of large landing parties before the mechanical contrivances took hold. There came finally the brilliant yet simple conception of the mooring mast. Both British and American experiments have now shown the most remarkable facts about the mooring mast. Its practicability was demonstrated on the recent transcontinental flight of the *Shenandoah*.

An airship can be tied up and released at the mast in weather in which it would be absolutely impossible to handle her in or out of a hangar, and can ride at the mast in winds up to sixty miles an hour, through rain, hail or snow squalls. Quite extensive repairs can be made at the mast, girders can be replaced, engines and propellers changed, and gas bags deflated and replaced by new ones. Only for very serious repairs and general overhaul will a shed be required. Hangars will not disappear, but they will be regarded in the light of a drydock in which an airship will be docked once every few months. A commercial company will build a number of mooring masts and only use one or two hangars at the main terminals. And instead of the three or four hundred men formerly required to land a ship, a ground party of one officer and ten men will be sufficient.

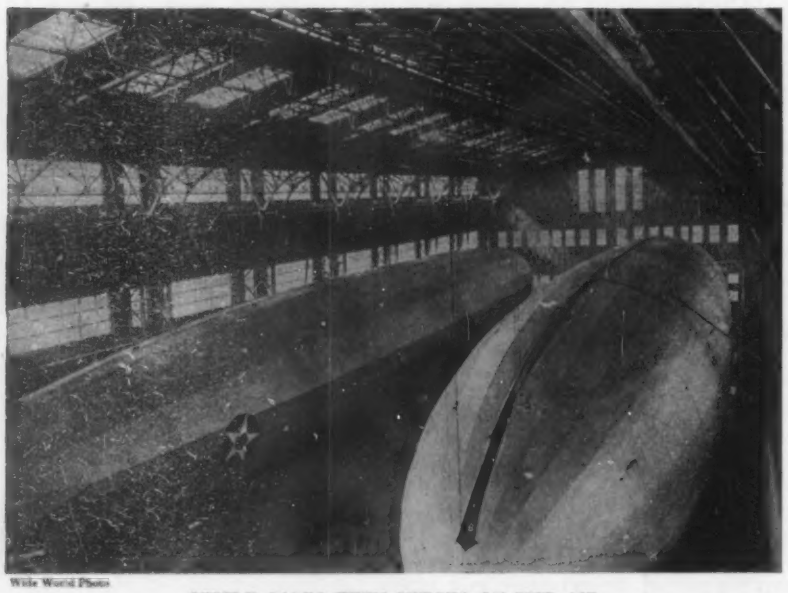
Nor does the pulling away of the *Shenandoah* from her mast invalidate the usefulness of the device. It is usually assumed that an airship when secured to a mooring mast will lie head-on to the wind and will be subject to no stresses except to



Wide World Photo

LIKE HUGE FINS OF A FISH

The great rudder of the ZR-3, *just after landing on United States soil at the end of her remarkable eighty-one hour flight across the Atlantic*



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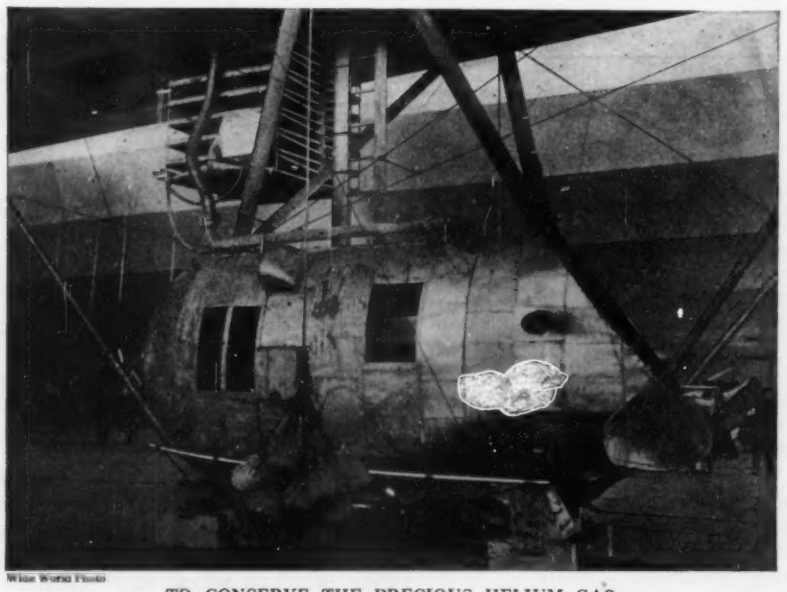
UNCLE SAM'S TWIN NIECES OF THE AIR

The Shenandoah *and the* ZR-3 *resting side by side in the hangar at Lakehurst after their recent record-breaking trips*



Wide World Photo

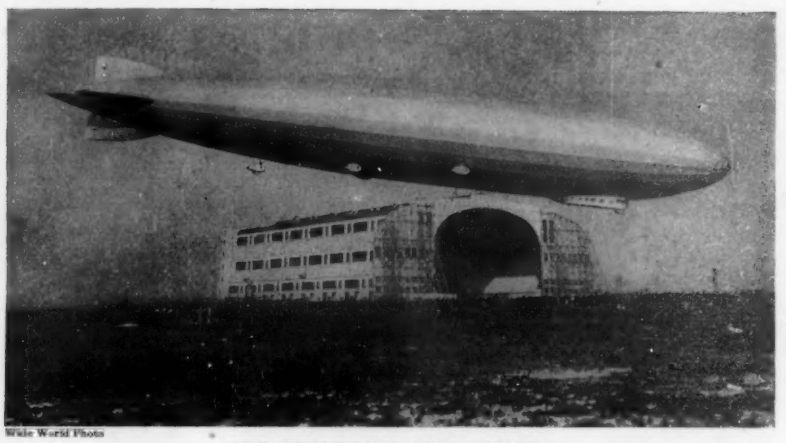
TO CONSERVE THE PRECIOUS HELIUM GAS

The above picture of the Shenandoah's *motor cabins is part of the apparatus which extracts from the exhaust gases the water to be used again as ballast*

Wide World Photo

THE GRAVE OF THE ILL-FATED *R-38*

This unlucky airship after remaining in the air for thirty hours on its maiden trip, broke in half, burned and fell into Humber River, with the loss of many lives



Wide World Photo

THE GREAT BIRD COMES HOME

As the ZR-3 *came down at Lakehurst, a well-trained ground crew of the Navy were ready to take hold of the infant giant and guide her into security*

a direct forward pull at the bow. As a matter of fact, owing to the peculiar aerodynamic instability of the airship hull, the actual position of equilibrium of a rigid airship is at an angle of several degrees to the wind, and momentary angles of ten degrees to the wind are not uncommon. Consequently the lateral force on the hull may be three times as great as the longitudinal force. Enormous bending moments may be introduced at the bow, as large as one million foot pounds.

No wonder the *Shenandoah* broke loose. Given a similar set of circumstances she would break loose again. The remedy is simple. Let the mooring connections be considerably weaker, the airship will break loose sooner but with no damage to the ship itself.

Masts are even now fitted with hydrogen or helium mains, gasoline and water pumps, so that a ship can be easily refuelled or regassed. The airship is maintained in correct trim by operating the water pumps and taking on or releasing ballast as necessary. A nice problem would be to devise a system of automatic ballasting which would maintain the ship horizontal under all conditions.

Are Airships Fair-Weather Craft?

Contrary to general belief, the airship is not a fairweather craft. If structurally strong, with good control, range and speed, it need not fear the most violent gale. What is of more interest to the pilot is circumventing the wind so as to lose as little headway as possible and not to drift too far off his course. To do this he must study meteorology carefully. In traveling over the Atlantic, for example, he knows that strong winds are caused by barometric depressions, that the resultant cyclones are circular in form and that strong depression centers move rapidly. If a pilot can diagnose the character of the wind and can determine, from wireless reports and his own observations, which way the depression is traveling, he will turn broadside to the wind and in a very short time pass through the bad zone. This calculation is obviously very difficult but can be accomplished, even aboard ship, if the pilot has long experience and a complete meteorological service, by radio.

Artificial Horizons Assist Pilot

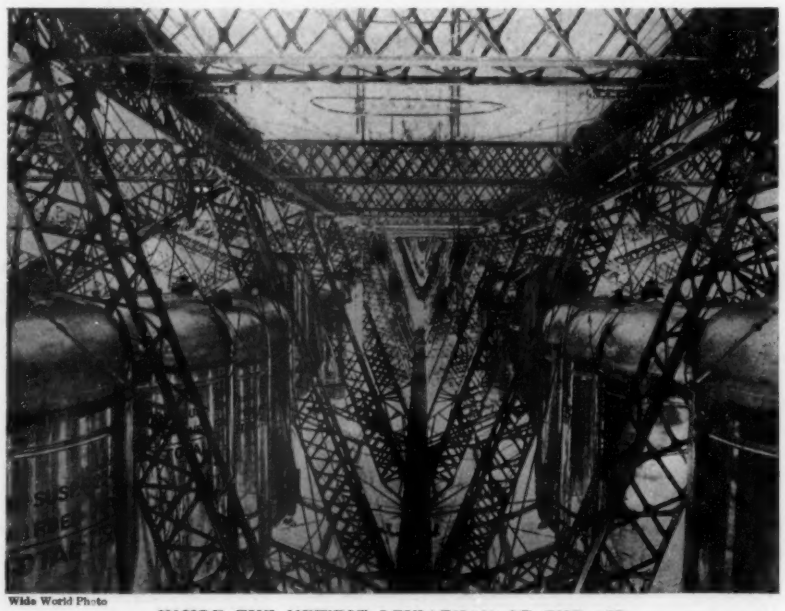
It is extraordinary what a number of problems requiring real ingenuity the dirigible develops. One great technical difficulty in studying winds seems baffling. The pilot can only judge whether he is close to the center of a depression by his barometer. But unfortunately this barometer serves also as altimeter and may read low, not only because of the presence of the center of a barometric depression, but also because the ship is at a considerable altitude. To avoid this confusion, the pilot must know his true height above the surface. There is at present no known method by which he can gage this true height above sea level. Some instrument or method to overcome this technical difficulty is urgently needed.

Neither clouds nor fog are serious inconveniences in modern navigation, when directional wireless and artificial gyroscopic horizons assist the pilot. Nor does the stability of the ship give much trouble when the ground or sea cannot be seen. It is practically impossible to land a ship in foggy weather, but ocean liners are just as much bothered by fog when entering a busy harbor and it is possible that a solution may be found, even under these conditions, by the use of the powerful searchlights and landing lights now so successfully employed by the night air-mail service.

There need be no hesitation in saying, in conclusion, that whatever difficulties may have to be surmounted in the operation of the dirigible, whatever improvements may yet come; strength in the air and at the mast; control in flight and on landing, whether in good or bad weather, are already definitely achieved.

Can Helium Prevent All Danger of Fire to Dirigibles?

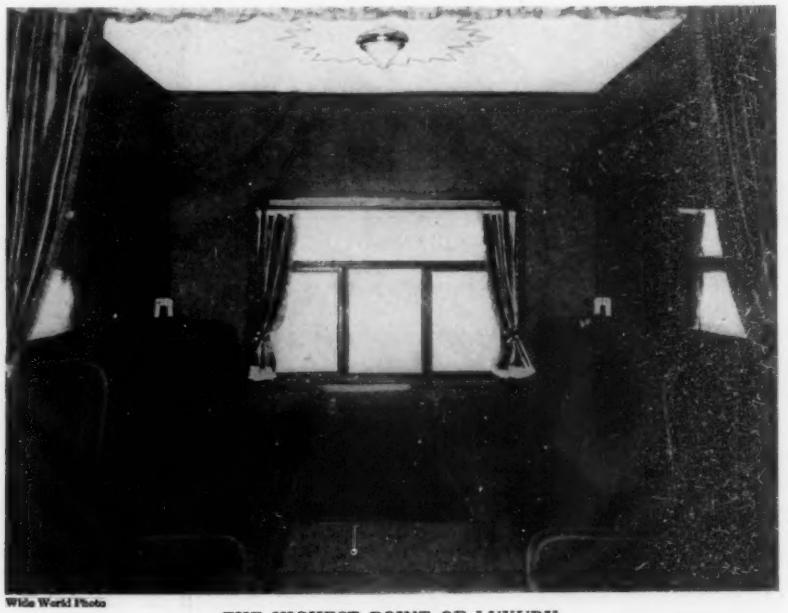
This vital question will be discussed by Professor Klemin in his next article in the February issue, out January 20th.



Wide World Photo

INSIDE THE NEWEST LEVIATHAN OF THE AIR

This interior view shows the immensely complicated frames of the corridors as well as some of the giant fuel tanks that are required to feed the powerful motors



Wide World Photo

THE HIGHEST POINT OF LUXURY

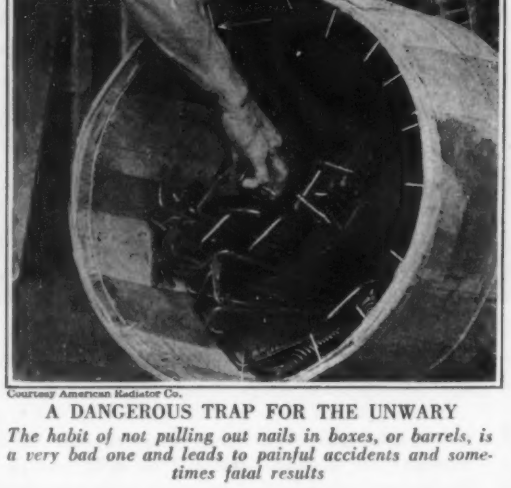
The passenger cabin of the ZR-3 *has all the luxury of a modern liner or railway coach. Even the baggage racks over the seats are not forgotten*

Common Accidents Easy to Avoid

Courtesy American Radiator Co.

FORETHOUGHT WOULD HAVE PREVENTED THIS

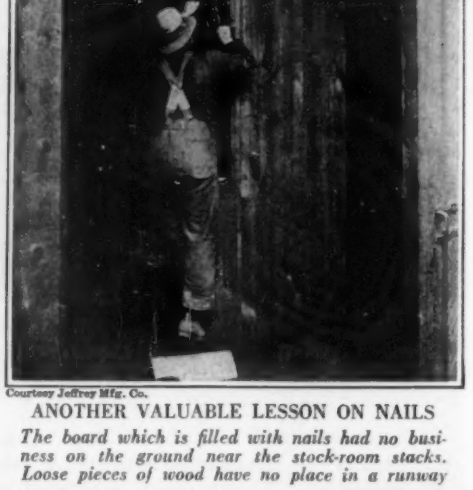
Had the man known what the nail in the barrel (at the right) would do to him, he would have been more careful. Now it is a case for the surgeon



Courtesy American Radiator Co.

A DANGEROUS TRAP FOR THE UNWARY

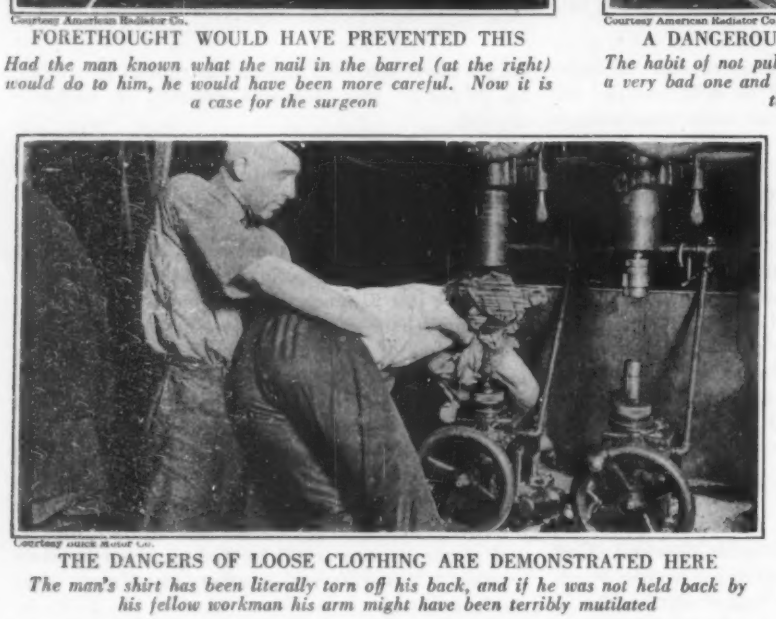
The habit of not pulling out nails in boxes, or barrels, is a very bad one and leads to painful accidents and sometimes fatal results



Courtesy Jeffrey Mfg. Co.

ANOTHER VALUABLE LESSON ON NAILS

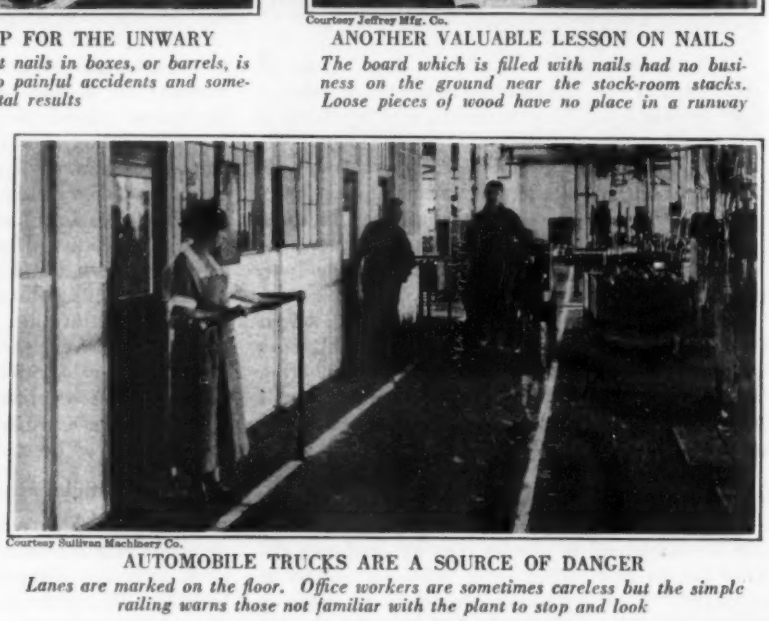
The board which is filled with nails had no business on the ground near the stock-room stacks. Loose pieces of wood have no place in a runway



Courtesy Buick Motor Co.

THE DANGERS OF LOOSE CLOTHING ARE DEMONSTRATED HERE

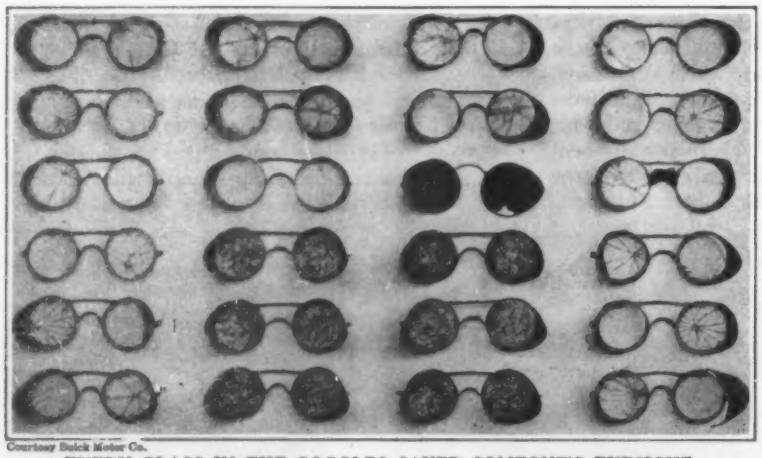
The man's shirt has been literally torn off his back, and if he was not held back by his fellow workman his arm might have been terribly mutilated



Courtesy Sullivan Machinery Co.

AUTOMOBILE TRUCKS ARE A SOURCE OF DANGER

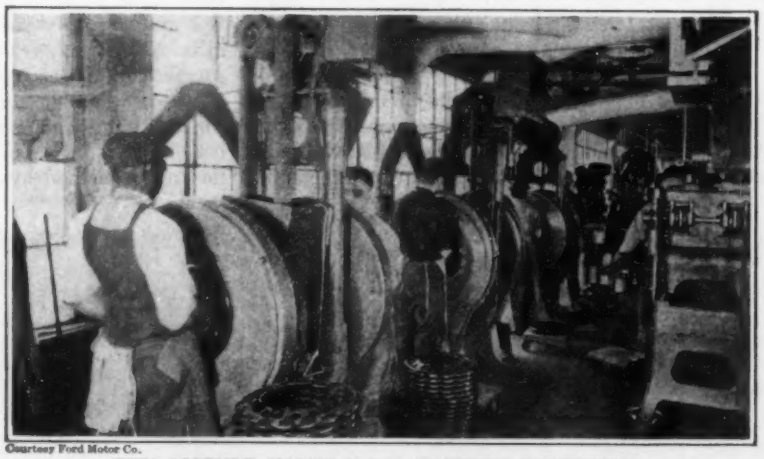
Lanes are marked on the floor. Office workers are sometimes careless but the simple railing warns those not familiar with the plant to stop and look



Courtesy Buick Motor Co.

EVERY GLASS IN THE GOGGLES SAVED SOMEONE'S EYESIGHT

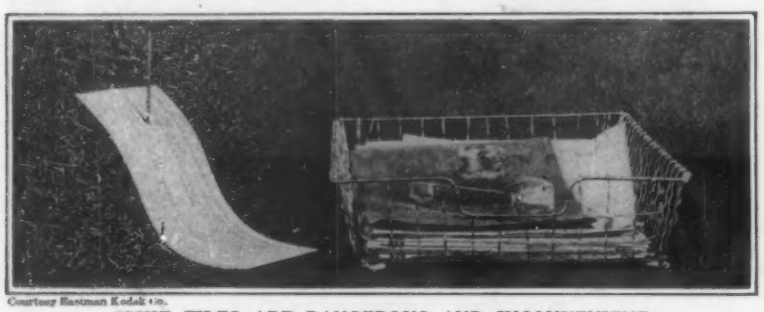
It is very hard to get workmen to use goggles, but once the habit is acquired it is apt to stick. Goggles are now ground to prescription



Courtesy Ford Motor Co.

THIS PICTURE SHOWS IDEAL FACTORY CONDITIONS

All grinding wheels should not only be properly guarded, but all the dust should be removed by suction in order to save the workmen from lung troubles



Courtesy Eastman Kodak Co.

SPIKE FILES ARE DANGEROUS AND INCONVENIENT

The office has its hazards as well as the plant. Even a cork on the end of a spike file does not make it safe. A wire basket and a paper weight is a great deal safer

Courtesy Eastman Kodak Co.

SAFE AND UNSAFE SHOES

The factory is no place for high heels. Our engraving shows a broken high-heeled shoe which caused a serious fall. A safe working shoe is shown to the right

New Bridge Saves Time

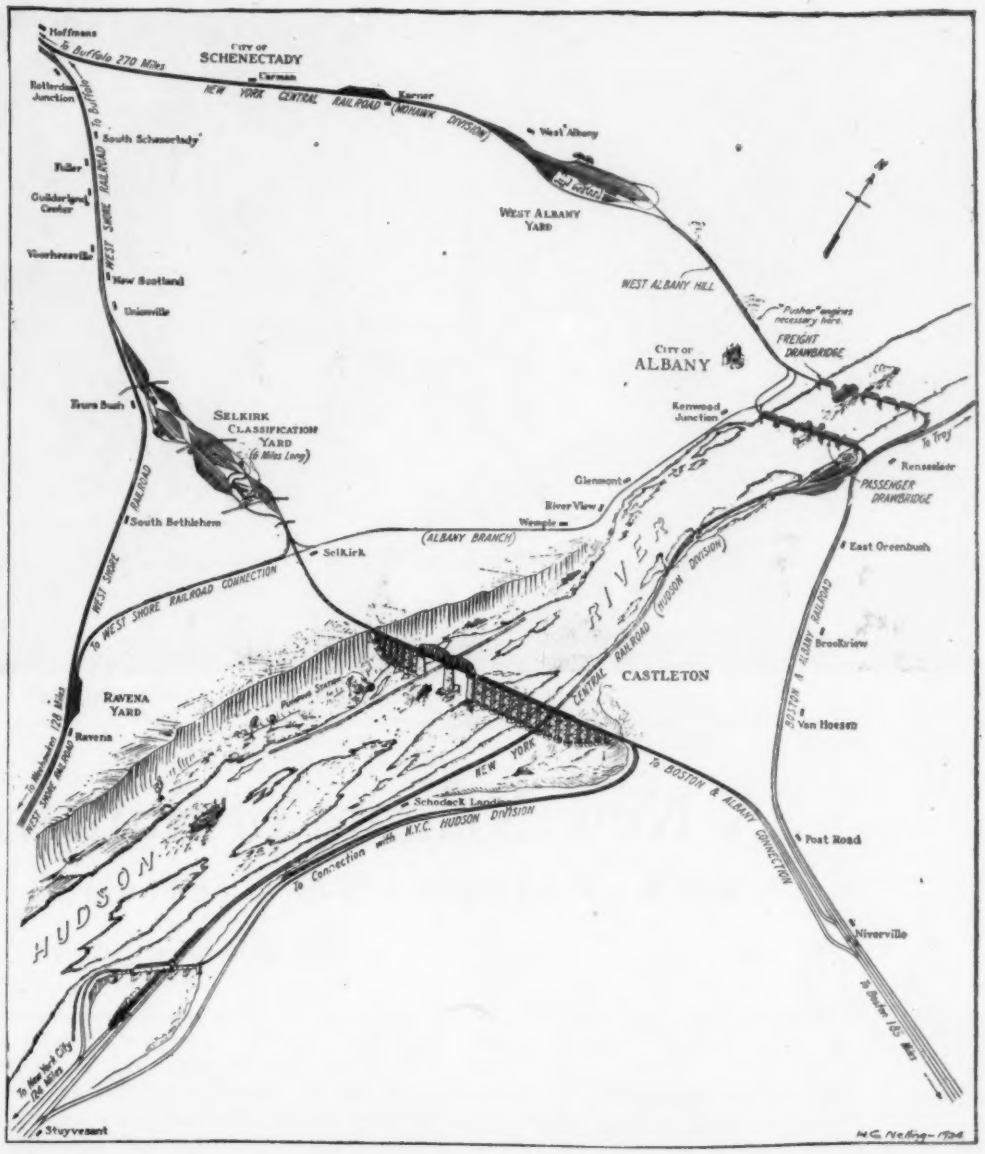
ONE of the important railroad improvements made in the United States in the last twenty years was opened for traffic on November 20, 1924.

This is the "Castleton Cut-off," by means of which freight traffic flowing over the six-track main line of the New York Central Railroad between the great agricultural west and the busy industrial territory east of the Hudson River is diverted from steep grades and congested trackage at Albany, N. Y., and shunted across a high-level bridge over the Hudson, ten miles below the capital city, by easy gradients.

Beside the high bridge, which eliminates heavy grades both east and west of the low drawbridges at Albany, the "cut-off" includes twenty-eight miles of new double-track railroad, and a vast terminal freight classification yard, probably the most modern and efficiently planned freight car terminal yards in the world. These yards mark the western terminus of the connecting railroad.

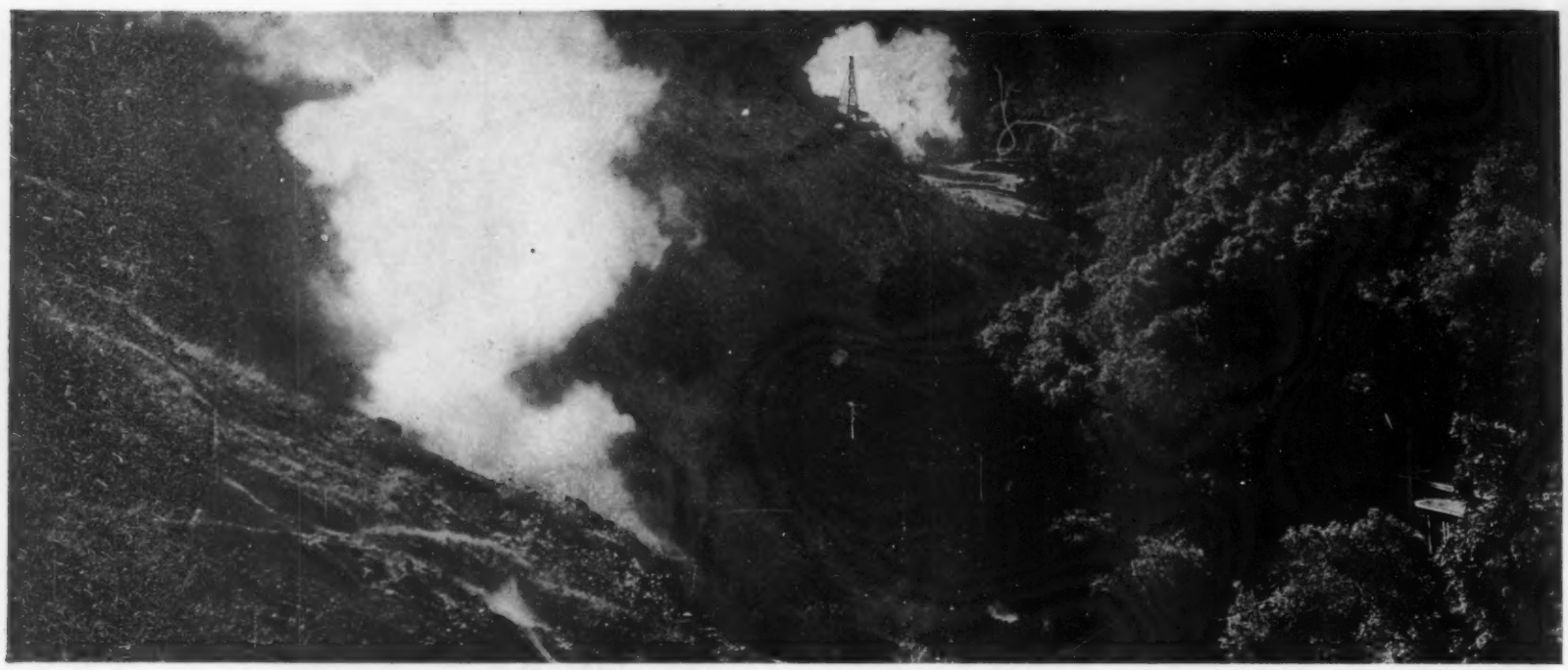
The cut-off cost $25,000,000 and by rapid work has been only two years in construction. Its outstanding feature is the "A. H. Smith Memorial Bridge" across the Hudson, a monumental structure a mile long, including approaches, carrying rails 150 feet above mean high water in the river below. The bridge has been dedicated to the memory of the late A. H. Smith. The improvement was conceived by him, planned in broad outline and carried through despite a greater number and variety of obstacles than usually confront such a large undertaking, through his tireless energy and tenacity of purpose.

The cut-off, the connecting railroad and the new Selkirk yard will provide an easy flow of freight traffic both to and from New England and New York through the Albany gateway. Congestion at this point will be eliminated and the movement of cars between western points and New York and Boston will be speeded up over existing deliveries from two to five days. Freight tonnage through this avenue of commerce can also easily be doubled without interference and without lessening the speed of the passenger service.



THE MILE-LONG SPAN PHOTOGRAPHED FROM THE AIR

Map and airplane view of the twenty-eight-mile "Castleton Cut-off," showing the "A. H Smith Memorial Bridge" which is visible from passing trains for miles up and down the river. This bridge has been dedicated to the memory of the late A. H. Smith who rose from laborer in a bridge gang to the eminence of one of the most brilliant railroad executives of his time.



WHERE MOTHER EARTH HERSELF PROVIDES THE STEAM

Looking up Alexander Valley toward the partially completed third steam well. More steam forces its way through the surface, as indicated in the foreground

A New Niagara of Subterranean Power

Will We Find Hidden Sources of Power in the Earth's Inner Fires?

By Uthai Vincent Wilcox

CALIFORNIA has a vast, and thus far unused, and practically unappreciated, source of power on tap in the geysers of Alexander Valley, situated in Sonoma County. This region has long been appreciated for its hot mud baths, and the natural beauties of its geysers. As such it has been a tourist attraction since the earliest days. Recently, however, Dr. Arthur L. Day, Director of the Geophysical Laboratory of the Carnegie Institution of Washington and Dr. E. T. Allen, Chemist of the Laboratory have completed tests that show tremendous possibilities in the use of the geysers for the purpose of power development.

Steam for Two Years

Borings have been made and already one steam well is in use, the steam of which is supplying power for the boring of other wells. Two steam wells that are now in use were sunk to a depth of about 370 feet and the third is well down. The first two have a constant steam pressure of thirty pounds to the square inch, and for the two years that they have been emitting steam there has been no diminution of this pressure. And this in spite of the fact that the two wells are only fifty feet apart. The third well is being bored about one-third of a mile up the valley and in a region showing no hot springs on the surface. This is in order to determine to what extent the entire region might be depended upon for the development of power.

In the tests it was found that there were no great problems standing in the way of the use of this natural steam for power purposes. From a test of the chemical properties of the steam, this was particularly favorable for industrial uses.

"Dr. Allen and I made examinations," Dr. Day said, "of the steam from these wells for the particular purpose of ascertaining the amount of uncondensable gases the steam contained. The quantity of such gases was unexpectedly small, amounting to only one and one-half percent of the total. This is a very favorable indication, from the standpoint of a commercial exploitation of the volcanoes as a source of power. That was one of the things the promoters had to contend with when the ancient volcano basins of Italy were first used for purposes of furnishing power.

Is This Someone's Idea of Hell?

THE place of eternal torment for the wicked is pictured differently by different races. Our own idea comes, historians tell us, from the conceptions of ancient Italians, men who had looked into the fiery throats of Vesuvius and Stromboli, who were familiar with steaming grounds and boiling springs like those now being utilized in this new California wonderland.

"There the quantity of uncondensable gases was about five percent, and it has been a considerable source of difficulty. The steam from Alexander Valley volcanoes, however, has a remarkably small amount of these gases. The acid content, too, is small. In fact, the quantity is so minute that I am sure it would have no corrosive effect on the wells' casings, the valves or any machinery that might be driven by it. At least it has not proved troublesome thus far."

Dr. Day said that no water was supplied to these wells, the steam being the result of water that reached the heated sections from some natural source. This water that reaches this volcanic section is of a steady and permanent nature for, although California has had one of the driest summers in many, many years the steam columns from these wells has shown no decrease of pressure. As a possible source of power this is most important.

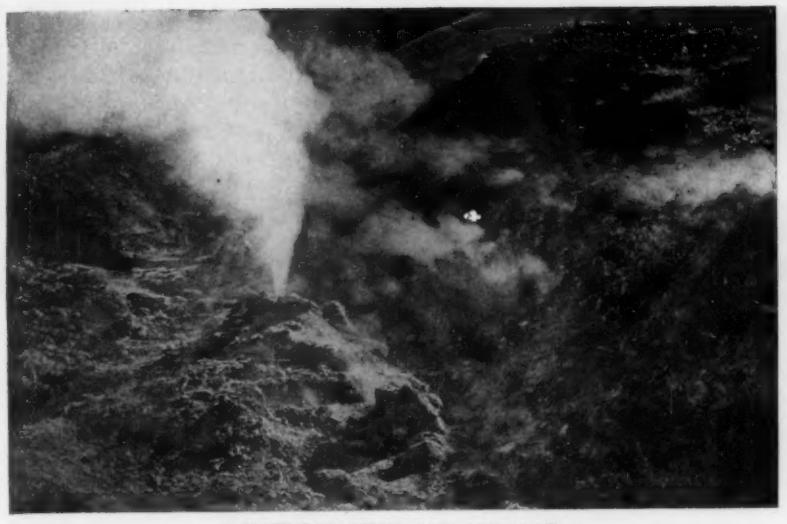
During the recent summer one of the large electrical corporations of America sent an engineer to this region to test out the possibility of power from steam wells. The results of his examination indicate that the total power of the two wells would reach at least 1,500 kilowatts an hour, and possibly more.

Once a Roaring Volcano

Large dynamos develop little more than 4,000 kilowatts an hour, in the great power stations, consequently there are tremendous opportunities here for a whole series of steam wells developing power equal to a Niagara. The entire Alexander Valley section, known as the Geysers, can be pitted with steam wells, making the comparison something more than a mere rhetorical expression.

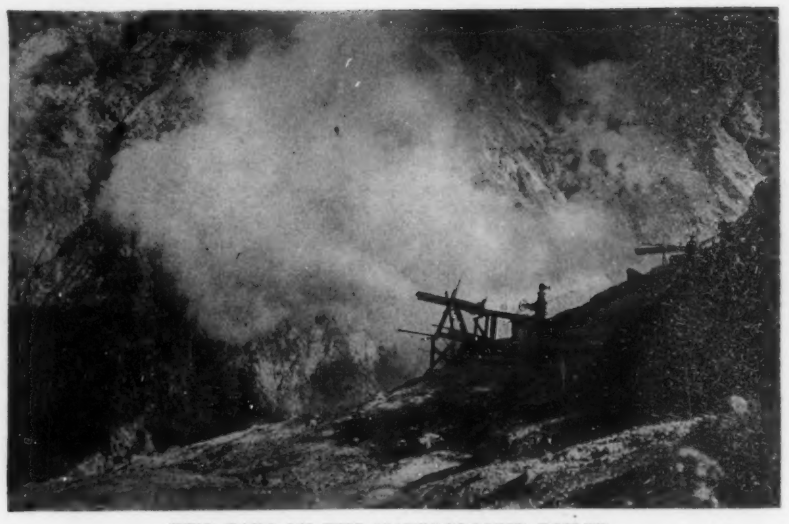
It is evident that this region was at one time, a roaring, flaming volcanic region. And not so very long ago either, for today it is possible in some regions to reach a temperature of 400 degrees only three feet below the surface. In many places the steam has broken out of its own accord and clouds the valley slopes.

Scientists say that these great steam reservoirs are made by a subterranean body of water crossing the ancient volcanic fires somewhere below the surface of the ground, and that as long as this water continues to flow there is no danger of a cessation of steam pressure. In boring the wells into this region, the usual oil-well equipment is used, that is, a churn drill and casing from top to bottom. At the desired depth the drill is removed and an ordinary valve guards the outlet, so that the engineer can call upon the volcano to send him the steam when he needs it.



A NATURAL VENT AND SEEPAGE

This vent is known as "Steamboat Springs." Steam pours continually out of a natural hole reaching down to the hot rocks below



TWO TAPS ON THE UNDERGROUND BOILER

The steam escapes from these two borings which are about 370 feet deep. The new well reached a temperature of 250 degrees, Fahrenheit, when down only 100 feet

"When these control valves are opened," Dr. Day said, "the roar of the escaping steam could be heard up and down the valley for a distance of at least two or three miles."

Both Dr. Day and Dr. Allen went to the valley to study certain mineral deposits that have resulted from the action of hot water on the geologic formations. These actions have produced astonishing effects. One result of the volcanic conditions are the streams of water that are veritable "rivers of ink." This black water due to the formation of pyrite, or sulphide of iron, from the action of hydrogen sulphide on iron bearing water, makes fairly legible writing fluid and was used for that purpose by the pioneers in early days. These two substances coming in contact with each other produce the chemical reaction that blackens the water.

There are also streams of snow-white color. These conditions are due to the fact that the water carries such a tremendous amount of salt in solution that when deposited on the beds of the brooks it coats them with a dazzling whiteness.

This region is of value for its quicksilver, large quantities of sulphide of mercury having resulted from the same reactions of Nature's Laboratory. Dr. Day found that the formation of cinnabar, a sulphide of mercury, is actually proceeding there now, and at such a rate that an iron plate embedded in a favorable location will be coated an eighth of an inch thick with this brilliant red mineral in a few days.

Mountains of Black Glass

Another interesting chemical side to this region of geysers, is the material known to geologists and physicists as obsidian, or black glass. Whole sections seem to be coated with this shiny smooth substance, so much so, that one region is known as "Bottle Mountain." The chemical sides of the volcanic region are nearly as interesting as the opportunities the region offers for power development.

The Italian engineers have certain difficulties to contend with in opening up new wells, but this California region seems to be ideally suited for the use of steam wells for power purposes. Long before the well is completed steam gushes out. In fact, in some parts of the valley, the writer has used a stout stick and poking it vigorously into the ground, has seen the steam come out with a slight hissing sound.

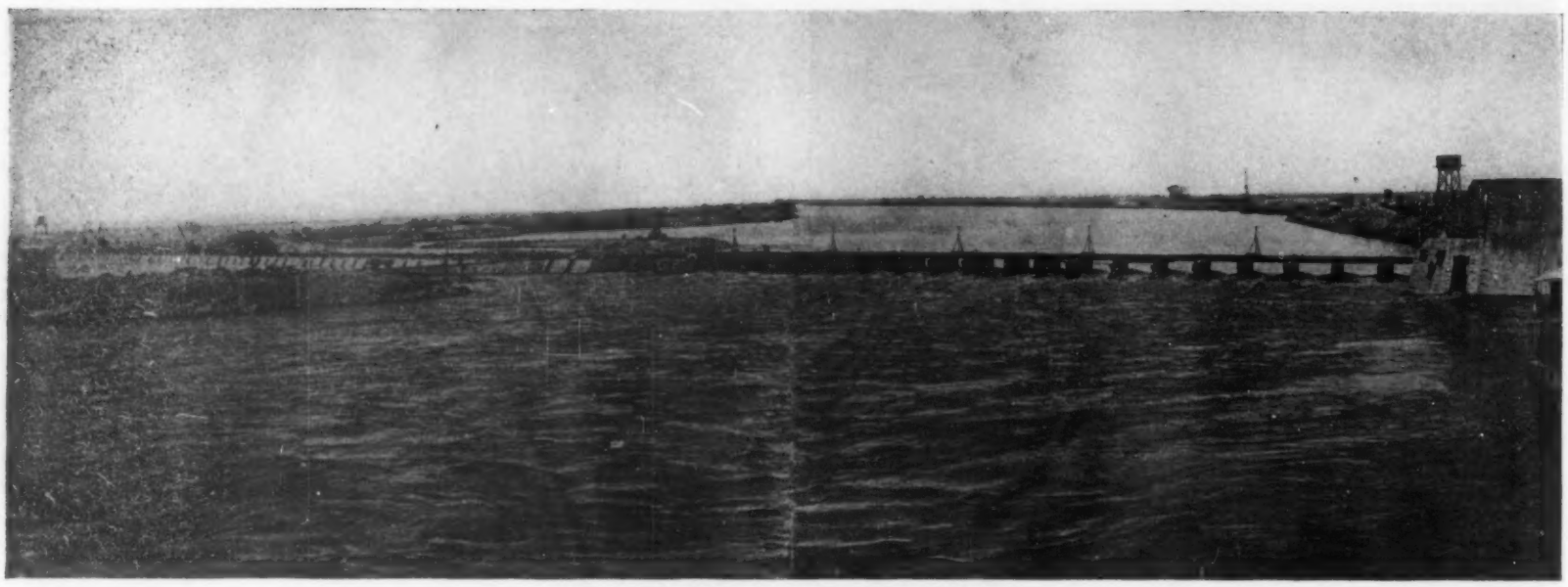
If the tests now being made in this geyser are satisfactory—and every evidence indicates that they will be—there are other sites in California and other states where industrial power may be obtained from subterranean sources. Lassen Peak has at least four such valleys, that, in the opinion of Dr. Day, should most certainly develop steam power. Steamboat Springs near Reno, Nevada, would be a possible source. The famous geyser region of the Yellowstone offers great opportunities for the use of industrial power taken from the earth's inner fires.

STEAM-SWEPT DESOLATION

The Geyser Canyon region resembles a great natural slag heap. Its weird desolation carries the impression of some tremendous holocaust that has burned the whole countryside to a veritable crisp

A NATURAL INK POT

This river of ink results from the action of hydrogen sulphide on iron-bearing waters. These two substances, coming in contact with each other, produce a chemical reaction that turns the water black



BIRD'S-EYE VIEW OF THE GREAT SENNAR DAM

This view is taken looking upstream showing one section of the dam well above the water level. The height of the structure may be noted by the wall on the extreme right. The flood waters now flow right over the dam wall on the left as well as over the gantry seen on the right

A Race with Nature

By Harold J. Shepstone, F.R.G.S.

A spectacular engineering feat is the construction of the great Sennar Dam, on the Blue Nile, in the Sudan. Here the engineer has been wrestling with the Nile floods and by herculean efforts is erecting an immense barrage, two miles in length, across the river, in order to hold up water for the irrigation of a million acres of parched land, where cotton is to be grown by means of hundreds of miles of canals.

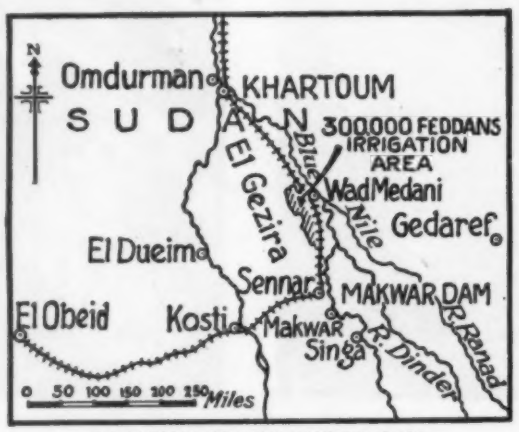
IN THE Sudan, literally in the heart of the desert, engineers have won a great victory over the forces of nature. They recently pitted their cunning against the annual floods of the Nile, and won. As a result, there will arise across the Blue Nile, below Khartoum, one of the greatest dams in the world. It will be nearly two miles in length and will, with its system of canals, cost upwards of $40,000,000. The Sennar, or Makwar Dam, as it is called, which is now nearing completion, is undoubtedly a spectacular and daring piece of engineering work. It is a greater undertaking than the erection of the Assuan Dam in Upper Egypt; a tougher proposition than the building of the Burrinjuck structure in the Blue Mountains of New South Wales, or any of the barrages which engineers have thrown across the Nile in Egypt.

There is no piece of engineering work that presents such varied problems as that of irrigation. You cannot carry water on to the land you desire to irrigate without first raising it to that level, and this means the throwing of a barrage or dam across a nearby stream whereby the water is held back and raised to the desired height. But you cannot erect a dam at any spot you like. A hundred and one points have to be taken into consideration—the nature of the bed of the stream, its distance from the area to be irrigated, the general lie of the land, the supply of the necessary materials, while governing it all is the important question of cost.

These conditions were found to exist at Makwar, an insignificant little village some 170 miles south of Khartoum, on the banks of the Blue Nile. The latter city stands at the junction of the White and Blue Niles. In the fork formed by these two rivers and for two hundred miles southward, is the Gezria Plain, and the object of the undertaking is to bring a portion of the vast acres of parched land under irrigation for the cultivation of cotton.

As already stated, the site of the new dam is at Makwar, some four miles below the town of Sennar from which the great barrage derives its name. Here the river is divided in its course by a small island, which has aided the engineers immensely, enabling them to deal with one section of the stream at a time. Furthermore, at this point a ridge of rock crosses the course of the river at no great depth below the surface and this was seized upon for the erection of the foundations.

First the western arm of the river, that portion flowing between the island and the western bank, was blocked and the bed of the stream laid bare. This was accomplished by throwing up temporary earthen dams or sudds, both above and below the stream, thus diverting the river into the remaining or eastern channel. As soon as this section of the river bed was freed of water, work on this part



LOCATION OF THE SENNAR DAM

This map shows the small fork in the Blue Nile where the dam is being erected

of the spectacular engineering feat was commenced.

Hundreds of men were set to work to dig out the river bed, it being necessary, of course, to go right down to the solid rock. Here and there it was found necessary to go down to a depth of forty feet and more below what was originally the bed of the stream. Then, along the site of the dam a temporary wooden platform, or gantry, was built. It consists of massive timbers carried on a forest of stout piles. On account of the enormous weight which the gantry has to carry, it was necessary to erect special but substantial brick and concrete bases. Some idea of its strength may be gaged when it is stated that locomotives run along it pulling trains of trucks each loaded with forty tons weight of stone, in addition to which there are numerous heavy cranes and other machinery. By means of the cranes the excavated material is raised and the stones lowered for the building of the great retaining wall.

Being a masonry structure huge quantities of stone are needed for the erection of the dam and this comes from a granite hill some thirty miles or so away which juts out of the plain to a height of 500 feet along a length of several miles. Here quarries have been established and an army of masons are continually at work here blasting and hewing out the stone, despatching a couple of thousand tons' weight of blocks a day down to the dam site. The necessary cement is manufactured on the site from material which exists in abundance in the vicinity. There is an up-to-date cement factory equipped with continuous kilns and tube grinding mills, capable of an output of 1,000 tons a week.

The dam will have a total length of 3,300 meters, or close upon two miles, about 1,000 meters longer than the famous Assuan structure. Its maximum height from the foundation will be over 120 feet. At its base the great retaining wall will have a width of some ninety feet, gradually tapering to fifteen

feet at the top, over which the railway will run. Over 15,408,000 cubic feet of masonry and 100,000 tons of Portland cement will be requisitioned in its erection. The total weight of the finished structure will be a million tons. The flow of the stream will be controlled by means of sluice gates. There will be eighty main sluices, twenty-seven feet high and seven feet wide; fourteen canal regulator sluices, seventeen feet high and just over ten feet wide; and 112 spillways. Approximately 3,300 tons of ironwork will be used in the sluice gates and operating machinery.

After the western section of the dam had been erected up to a height above the sluices, work was begun on the eastern channel. This section of the river is not only wider, but much deeper than the other channel and, as a result, it entailed much more complex work on the sudds. These huge earthen embankments were consequently strengthened by steel sheet piling.

It was the desire of the engineers to prevent, if possible, the re-sudding of the channel again another season. This meant that they had to divert the flow of the stream back again to the western channel, excavate the bed of the stream for foundations, and build up the great retaining wall sufficiently high to allow the remaining work to be continued with the river flowing through the sluices. According to their contract they had only nine months to carry out all this work and the question was, could it be done?

The Blue Nile rises in the mountains of Abyssinia and during the rainy season, which lasts several weeks, the flood waters pour down from Abyssinia with enormous and apparently uncontrollable force. Could the second half of the dam be raised before the floods came? The engineers made their calculations and declared it could be done. It was nevertheless an anxious time. In the first place one could not tell for a week or two when the floods would actually come. In excavating for the foundations they struck nasty "pockets"—loose patches of earth and stone—which delayed them and other unexpected little obstacles kept on cropping up. But the work was pushed on day and night and it developed into a race against the coming floods. Slowly the great wall arose and when it had reached the desired height preparations were made for removing the cranes and other heavy machinery from the gantry. This accomplished the platform was taken down. Hardly had this been done when the river rose above the platform.

But the engineers had won!

Today the waters pour over their dam and the gantry, but when the waters begin to recede again work will be resumed and the structure raised to the intended level.

A SCENE OF NOCTURNAL ACTIVITY

In their race against floods the engineers found it necessary to work continuously day and night. The dam is seen slowly rising in the deeper or eastern channel

THE DAY FORCE IN FULL SWING

In digging the foundations for the dam in the center of the river it was necessary in places to go down forty feet below the bed of the stream before solid rock was found

It will result in the formation of a lake fifty miles long, two miles wide, with an average depth of fifty-six feet, a sufficient quantity of water to supply the needs of half a dozen large cities. By means of canals, spreading out over the land like the veins of a man's hand, water will be carried on to the now semi-parched land. The main canal is no mean stream. It has a length of sixty-two miles and has a width of eighty-seven feet at the bottom. In addition there are 900 miles of ordinary canals, 3,125 miles of irrigation canals and 5,625 miles of field channels.

The total excavations in the minor and subsidiary canals and field channels alone (not counting the main canal) amount to nearly eight times the volume of the Great Pyramid of Gizeh. What will, perhaps, give a better idea of the enormous quantity of digging involved is the fact that if the excavated soil were made into bricks they would suffice for the construction of a wall, five feet high and one foot thick, entirely round the earth at the Equator. The larger canals are being dug by American and English Bucyrus excavators, working on the dragline principle, and these huge machines are working day and night to complete the work within the contract time. The canals, in fact, are actually costing more than the dam.

As a result of these thousands of miles of channels some 300,000 acres of what is now virtually waste land will be brought under cultivation. By means of future additional work, it is anticipated that a total area of a million acres will be reclaimed.

Will This River Cross the Desert?

LOS ANGELES needs water. The famous Owens River Aqueduct is already overtaxed. Ranchers of the Owens Valley resent—even by armed attack—further diversion of this supply. So the Southern California engineers plan to astonish the world again. They propose to lead a part of the mighty Colorado across deserts and mountains to the coast. This remarkable project will be described in our next issue—out January 20.

Methods of Testing Chauffeurs

Tests for Determining the Caution and "Fear-Reaction" of Men Who Have Charge of Motor-Driven Vehicles

By H. S. McCauley

IS HE QUICK ON THE TRIGGER?

The time that elapses between the throwing of a switch that causes a blinding electric flash, and a signal shows that the subject has manipulated a brake pedal and switch, determines whether he possesses quick reaction

STEPS which it is expected will end in the weeding out of unfit chauffeurs from the taxicab industry of the United States have been taken in Chicago. A set of psychological tests have been formulated which, it is declared, will determine in a very short while whether the subject of the examination is safe—from a physical as well as nervous standpoint—to trust with the charge of a power-driven vehicle.

These tests, originated by Dr. A. J. Snow of Northwestern University for members of the National Association of Taxicab Owners, have been applied to many thousands of experienced chauffeurs in Chicago, and in considerably more than ninety percent of cases the record made by the subject corresponded accurately with his record as shown by the personnel card of his employer. That is, a driver who made a poor showing in the test given by Dr. Snow would always be found to have a considerable number of accidents against him on the personnel card, while one who came through with a good grade would be found to have a comparatively clean accident record.

Who Are the Unfit?

Dr. Snow starts with the theory that the big thing to look for in a chauffeur is not intelligence, but certain nervous and mental qualities. The chauffeur, Dr. Snow said, needs just enough intelligence to enable him to carry out plain orders, to read, write, do simple arithmetic and to learn the streets of a city readily. But he must be cautious by nature. If he is of the sort who will be careful when the boss is looking and careless at other times, he is unsafe. The thing to do, then, is test him for caution without his knowing it. And further, the psychologist declares, the chauffeur must react quickly in the face of an emergency. He must have what psychologists call "quick fear-time reaction."

Dr. Snow gives a test for intelligence, based on the same principle as the United States Army intelligence test, but in his test the subject matter deals more with things of interest to the motor vehicle business.

The most important part of the examination starts when the caution test is given.

On a plain kitchen table lie a dozen or so objects of every day life—a book, a small sack of salt, a paper bag of flour, a box of eggs, a single egg, an uncorked can of gasoline, a corked bottle labeled "gasoline," an electric light bulb, a small bottle containing lubricating oil, and various other objects. Close at hand stand three small and oddly constructed tables. One has legs which wobble astonishingly. Just a gentle push and the whole thing collapses in a heap. Another has just room on top for a square pan partly filled with water. The third has but three legs and the top is so placed that too much weight on one side will upset everything. In addition this table has a lighted candle on it.

The subject is instructed to remove the objects from the kitchen table and place them as he pleases, but as quickly as possible, on the other three tables. It is not permitted to go into too great detail, lest this test be evaded. However, the time taken by the subject to transfer the objects, and the disposition he makes of them with regard to the three smaller tables, obviously give illuminating information as to whether he is by nature careful or careless.

Gasoline and a Lighted Candle

The third test is the most important, for it shows what can be brought to light by no other means—whether the subject is quick on the trigger, or whether an oncoming accident is likely to happen while he sits gazing in astonishment. This test is given in the dark and utilizes an elaborate electrical apparatus, which is, however, simple in principle. The subject is told what he must do in case of an emergency. The emergency is supplied in a most startling manner, and a measurement is made of the time taken to perform the directed act after the oncoming "accident" is in sight.

In a darkened cabinet the subject sits before a table on which rests a most formidable aggregation of coils, wires, tubes, switches and other impedimenta. His left hand is placed upon a contact key, and he is told to keep it there no matter what happens. His left foot is placed upon a brass plate on the floor, and he is instructed that it must not be removed under any circumstances. Should either the left hand or the left foot be lifted, the fact will be signalled immediately to an observer outside.

The right foot is placed upon a brass plate similar to that on which the left foot rests, but to the right of it on the floor lies a pedal resembling an automobile brake pedal. Directly before the subject on top of the table is a board on which is a row of small electric globes, a row of binding posts, and a row of small coiled wires whose ends are handy to the binding posts. On the table to the right is a small electric switch. This lies approximately above the footbrake pedal which is on the floor to the right of the right foot.

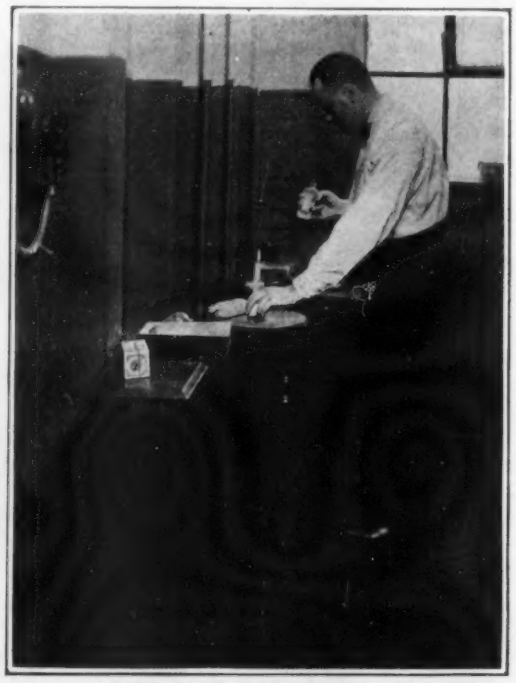
"Now," the subject is instructed, "you are to keep your left hand on the contact key, and both feet on the brass plates. With your right hand you are to insert the ends of the coiled wires in the binding posts and turn the screws down. If, while you are doing this, *anything unusual* happens you should immediately stamp your *right* foot on the brake pedal to the right of it, and turn with your *right* hand the electric switch to the right of it."

The door to the cabinet closes and the subject is left alone in the dark. He proceeds with the insertion of the wires in the binding posts, and notes that as he does so the little electric globes before him light up. Suddenly there is a heart-stopping crash of sound as a dazzling electric arc jumps through the darkness in front of him. His left hand gets a shock from a small spark gap directly above it, and his right hand gets another one.

If Anything *Unusual* Happens—

If the subject has quick fear-reaction his right hand and right foot spring immediately to the electric switch on the table and the brake pedal underneath it. If he is slow he will sit stupefied for a minute before he makes a move. The period between the time when the observer outside turns on the arc and an electric signal shows him that the brake pedal and the electric switch on the table have both been manipulated is what determines whether the subject possesses the requisite quickness of muscular reaction.

It will be noted that while this test simulates in a general way the bodily position of a man driving an automobile, the locations and actions of the hands and feet are not identical with what they would be under such circumstances. This arrangement is made purposely, in order that the subject may not profit by any previous driving experience he might have had. It is not desired to test the "muscle education," but the mental reaction.



IS HE CAREFUL OR CARELESS?

The disposition that the subject makes of the various objects, which include a lighted candle and an open can of gasoline, gives illuminating information as to his caution

The Psychic Investigation

"Report of Progress" from "Margery's" Point of View

By L. R. G. Crandon, A.M., M.D.

IF anyone advances anything new which contradicts, perhaps threatens to overturn, the creed which we have for years repeated, and have handed down to others, all passions are raised against him, and every effort is made to crush him. People resist with all their might; they act as if they neither heard nor could comprehend; they speak of the new view with contempt, as if it were not worth the trouble of even so much as an investigation or a regard, and thus a new truth may wait a long time before it can make its way." ("Conversations of Goethe.")

In the November number of the Scientific American the committee appointed by this journal for investigation of psychic phenomena presented a "report of progress" concerning its observation on the "Margery" mediumship. This report showed that the committee members were either wide apart in their conclusions, or undecided as to the validity of the phenomena they had observed. Under any circumstances the subject of "mediumship must, at present, be a controversial one. The committee have made certain statements, and those interested in "Margery" must, perforce, take issue with those who, directly or indirectly, either impugn the character of the medium or the validity of the phenomena which occur in her presence. For this purpose the Scientific American has kindly opened its columns to us.

In the first place, as to the character of the committee: on paper it could not be improved upon. There was William McDougall, Professor of Psychology at Harvard; Walter F. Prince, Chief Research Officer for the American Society for Psychical Research; Hereward Carrington, for years student and writer on psychical subjects; Daniel F. Comstock, physicist at the Massachusetts Institute of Technology; and Houdini, the Handcuff King. Our experience, however, has shown this committee to have certain very bad qualities. Most important has been an entire lack of harmony and confidence. Houdini will not trust Dr. Carrington and Mr. Bird. Carrington and Bird return the compliment. At a committee sitting Dr. McDougall assures the circle that he has perfect control of the medium's left arm and leg, whereupon Dr. Prince says: "Of course I know nothing of that."

(1) Dr. Prince, in three of his sittings, reports that phenomena occurred. In these sittings he exercised as much control as one man can, and his colleagues controlled every other channel of fraud or error. Yet his report is couched in terms taking to himself the exclusive right to control every critical region. If this right be granted him, and if his colleagues be granted the rights of exception and suspicion which he exercises himself, it is not clear how it will ever be possible to satisfy more than one member of the committee. His work of research should be conducted alone while he maintains his present attitude toward his colleagues. He needs a committee of one!

(2) Dr. Comstock implies that phenomena in the dark mean nothing but incubation; that he wants phenomena in the light. With this wish anyone can sympathize. But I must point out that:

(a) This aspect of his report is at variance with his repeated statement to me: "Doctor, there are plenty of psychic phenomena here."

What This Statement Is

IN the issue of the SCIENTIFIC AMERICAN *for November, 1924, on page 304, we published signed statements from four members of the Scientific American Psychic Committee giving their opinions of the status at that time of the remarkable "Margery" case.*

Subsequent to the publication of these statements mutual friends of the Psychic and of the SCIENTIFIC AMERICAN *suggested that we publish a statement from the viewpoint of the medium, not as a matter of controversy with the committee—or with anyone—but merely that all existing points of view concerning this famous case might be presented to our readers.*

Such a statement has kindly been supplied by Dr. L. R. G. Crandon, of Boston, husband of "Margery." It is printed herewith. As was done with the statements from the members of the committee, this statement is printed without editorial change.

The investigations of the Committee into the Margery case are still in progress. On December 31, 1924, the period of application for the Scientific American Psychic Award expires, that being the time set when the Award was offered. However, the terms provide that applications under investigation or pending on the last day will be concluded by the committee. This applies to the Margery case.

The Editor.

PHOTOGRAPH TAKEN AT ONE OF THE SITTINGS

Notice the extraordinary luminosity in front of the medium. This is presumably so-called ectoplasm. In the photograph itself a large white hand can be seen pressing on the flapper of the bell-box. Perhaps more interesting is a small baby-like hand clasping the little finger of the sitter on the left

(b) In his own words: "Why do these manifestations need darkness or red light? I don't know! Don't blame me! I did not make the universe, nor its psychic laws." The manifestations in this circle are not miracles, but orderly phenomena, subject, presumably, to natural laws.

I have all confidence in Dr. Comstock's integrity of purpose. I regret that his conscience and his sense of responsibility seem to be such as to make him try to find the psychic laws before he announces the facts, and the facts in this investigation are all that are asked of him. He apparently wants to write the *final* chapter of psychic research, in a situation where all that is called for is the mere certificate of reality for a single type of psychic phenomenon. At present Dr. Comstock is away indefinitely. When, on his return, he observes the bell-box phenomena now being shown in red light to Dr. McDougall, I believe his last objection will be removed.

(3) Dr. Carrington's statement is a contrast to the others. He has seen valid psychic phenomena, and he says so. His report is simple, honest and explicit; it checks perfectly with the official notes of the sittings attended by him.

(4) Regarding the report of another member of the committee I insert, without comment, an exact complete copy of the official notes of a sitting.

Ediphone record, dictated during sitting.

"Sitting held at 535 Beacon Street, July 24, 1924, at 8:40 o'clock.

"Order of sitting: Psychic, on her left Houdini, on his left Mr. Munn, next Conant (assistant to Dr. Comstock), next Dr. Crandon, next Mr. Bird, and then Psychic again. Mr. Bird not in the circle but controlling the Crandon-Psychic link.

"On the outside of the circle Miss Wood and Dr. Comstock. No one else in the room.

"Sitting started at 8:45.

"At Walter's* request the lights were turned on, the new table with the depressible top was removed, and a card table with the locked contact box on it and other more familiar utensils was put in its place.

"When the lights were turned out again the time was 8:51.

"Pause. 9:00. Bird says the right-hand wing of the cabinet moved an inch or two in toward the Psychic.

"Houdini says something touched his right knee. At the same time Walter's remark was, 'Ha, ha, Houdini.'

"Bird says the megaphone just moved a bit on the floor.

"9:02. Megaphone moved and cabinet shivered, says Bird. Cabinet has opened up widely at the right.

"Regarding controls, Houdini says that during the time he was touched on the knee, and for some time before and after, he had hold of the Psychic's left hand with his right hand and his right foot and lower leg is against her left foot and lower leg. At the same time Bird had firm grasp of the Psychic-Crandon hands with his left hand and his foot was originally in front of Psychic's in contact with her toe. After the first movement of the megaphone he shifted his foot and put it behind hers in contact with her foot, between her foot and the megaphone, the megaphone originally being on the floor at Psychic's right. Conant says from the start he has had Dr. Crandon's right foot and lower leg and right hand.

"Pause. 9:05. Bird has just acquired control of Dr. Crandon's left foot and all other controls are as formerly, that is, as just dictated.

"Pause. 9:09. Houdini says he feels the cabinet moving against his right arm. He has control as before dictated. Corresponding movement reported by Bird of his wing. He has controls as formerly dictated, including Dr. Crandon's left foot.

"Pause. 9:10. We suddenly noticed that the victrola had stopped. Comstock went out to fix it and started it going again. Walter says, 'I didn't stop it.'

(*Continued on page 62*)

*The name of the "Control."

From a drawing specially made for the Scientific American by Arthur T. Merrick

The Size of the Universe

The Third of a Series of Articles on the Real Nature of the World

By Nicolas P. Rashevsky

Special Lecturer at New York University; formerly of the Russian University at Kieff and of the Department for Russian Students at the University and Polytechnicum at Prague.

IF you look up on a moonless night into the sky you may be able to count one or two thousand stars. With modern telescopes, and taking into account the whole sphere of the heavens, astronomers reckon the total number of the visible stars, clusters and nebulas as possibly one or two billion. The most distant of these, so far as we now know, are some 220,000 light years away from the earth, one light year being the distance covered in a year's time by a light ray moving continuously at the astounding speed of 186,000 miles a *second*.

This far, at least, into the depths of space the eye of man, aided by his optical inventions, has been able to penetrate already. Many philosophers would think this more than enough.

But science is never satisfied. No sooner had the astronomers stretched their telescopic measuring rods as far as this than the theoretical physicists began asking themselves whether this was the end. Is there *any* end? And if there is, where lies this ultimate boundary of the universe and what is this ultimate boundary like?

Can Time Be "Curved?"

One attempt to answer these questions has grown out of the developments of theoretical physics that cluster around the theory of relativity. It is the idea of the "radius of curvature" of the universe and of the "curvature of time."

At first sight this seems the most utter nonsense imaginable. How can time be "curved?"

Let us recall, first, some of the conclusions that we have reached already in these articles. One of them is the conclusion that both time and space—or rather our ordinary ideas of time and space—have been built up, really, by the properties of the body and mind of man. Our three-dimension space conception is due to the fact that we see objects and feel objects in this way. Our idea of a uniform flow of time is due to the still mysterious chemical changes that go on continually in our nervous tissues. All this was explained in detail in the article last month.

Furthermore, we saw in the first article of this series that it was quite possible for us to imagine other kinds of space; that space might be "finite" and still "unlimited;" in a word that it is possible to conceive the real world as a very different sort of thing from the thing that it appears to be to our limited and fallible senses.

Either time or space *might* display, therefore, properties much more surprising than a mere "curvature." Let us see, now, just what this "time curvature" means.

Consider the idea of motion. Imagine a bullet fired from a gun on earth and moving outward into space. Let us assume that it travels with what we call a "uniform" speed. By this we mean that during each second the bullet travels the same number of feet or miles; for example, one mile a second.

But how do we measure this mile and this second? Obviously by the measures used on earth. The second we measure by some clock that has been set or corrected, in the last analysis, by our greatest terrestrial clock, the rotation of the earth. The mile we measure in earthly miles.

But what assurance have we that this second of time and this mile of space will remain the same as our bullet travels outwards away from the earth where these units were established? Possibly there are parts of space where time is different. It is even possible, as we have seen, that the properties of space itself may change, so that a mile, off on some distant star, is not the same length as a mile on earth. Even if we rode along with the flying bullet, carrying with us a terrestrial clock and a terrestrial yardstick, we could not be sure that these might not change as we flew along.

If they did change that would amount to a "curvature" of the universe. If the clock changed it would mark a "curvature" of time; if the yardstick changed that would mark a "curvature" of space.

Let us consider, as we have done so often before in these articles, the analogy of the curved surface of our own earth. If you set up at any one spot on earth the arrangement of a water-filled glass tube with a bubble in it that we call a level, you will observe that this level indicates a line which is practically parallel to the earth's surface. This is what we call a "level line." Now, move the level across the country for a thousand miles or so and set it up again. If you have preserved the direction of the first level line, as, for example, by comparing it with the direction of the pole star from the north pole of the earth, you will see that the second level line does not have the same direction as the first one had.

This proves, we say, that the surface of the earth is curved. Quite so, but it might be said equally well to prove that levels have the property of altering in just this way when moved from place to place. In fact, what we call the curvature of the earth might be defined, if one wished, as the degree to which levels alter in behavior when moved through a certain distance on the earth's surface.

Measuring This "Curvature"

In analogous fashion, if the yardstick and the clock that go along on the flying bullet alter their behavior as the bullet progresses, you may say that the space-time through which the bullet is passing is curved and that the degree of alteration in the "length" of the yardstick and the "time" of the clock are measures of this curvature.

This space-time through which the bullet flies is, you remember from the preceding article, merely another name for the universe. Accordingly we say that any alteration of clocks or yardsticks from one part of the universe to another indicates that the universe is curved. That is really all that there is to the idea of the "curvature of time."

So much for the *idea*. It is much less easy to determine as a *fact* whether space and time actually are curved. If, for example, all the measuring sticks that you have along with you on the bullet alter to

exactly the same degree, if the substance of the bullet alters similarly, if you yourself suffer exactly the same amount of shrinkage or expansion; *you will never know that anything has changed at all.* Similarly, if all your clocks on the bullet go slow or fast by the same amount there will be no way to detect the change.

To detect the fact that the clocks (or the yardsticks) are changing you will have to let the bullet go off by itself. You will stay here on earth, watch the clock and yardstick on the bullet through a telescope and be able, then, to compare these instruments with similar ones that you have kept beside you here on earth.

But how does all this help us, you say, to determine the size of the universe? We cannot actually put a clock or a yardstick on a bullet and then watch them through a telescope as they fly off through space.

No, but we possess a clock that is already in position off in some of the most distant stars and that is built in just the same mechanical fashion, we believe, as similar clocks that are here on earth. These clocks—both here and there—are the atoms of matter, especially the atoms of hydrogen.

According to the modern theories of atomic structure, for which there is now an overwhelming amount of evidence and which have been accepted by practically every competent scientist in the world, the atom of hydrogen consists of two very tiny particles, the electron and the proton. The proton occupies the center point of the atom. The electron revolves around this, much as our earth revolves around the sun. And like the earth, the planetary electron in the hydrogen atom makes one revolution in a definite period of time. Our earth needs a full year; the electron makes its revolution in a very small part of a second.

Clocks on the Distant Stars

This electron revolution would serve as a clock to measure time, just as the revolution of our earth around the sun serves to determine the length of the year. And, curiously enough, there is a way in which we can learn of the revolutions of the hydrogen electrons off in stars that are billions on billions of miles away. This is done by means of the light rays that the glowing hydrogen atoms send out.

When hydrogen is burned here on earth, or when it is caused to glow by electricity inside a vacuum tube, it sends out light of certain definite colors, the so-called spectrum lines. These lines can be seen separately in the instrument called the spectroscope. So definite and precise are these spectrum lines that the chemist can use them to detect the presence of hydrogen in a sample of unknown gas.

Now the exact position of these hydrogen lines in the rainbow-strip or "spectrum" depends in a complicated but definite way, upon the revolutions of the electrons in the hydrogen atoms that are sending out the light. If the speed of these electrons decreases, so that they make fewer complete revolutions around their atomic suns (the protons) in a second, that will shift all the spectrum lines a very little toward the red end of the spectrum.

You see what this means. If we examine in the spectroscope the light from glowing hydrogen atoms off in some very distant star and if we then compare the spectrum lines from these stellar atoms with the same lines produced by hydrogen atoms here on earth, what we are doing actually is to compare *clocks* on the star with similar clocks on earth. Any difference in the rates of the hydrogen clocks will appear in the spectroscope as a slight shift of the star-formed hydrogen lines as compared with the earth-formed ones.

This remarkable observation has been made. It is found that the lines from the stars actually do shift. But, unfortunately, the interpretation of this fact is not entirely easy.

This shift may mean a difference in time. It may mean, that is, that time actually runs a little slower in the stars (according to our clocks) than it does on earth.

But there are some uncertainties. For example, other things beside a slowing up of time may affect the exact position of the hydrogen lines. One of these is the relative motion of the star and the earth. If they are moving rapidly away from each other all the spectrum lines will shift a little toward the red end, which is exactly the same effect produced by the slowing up of time. The test is not as definite and final as might be hoped.

Such as it is, however, it gives us the best indication that we have of the size of the universe and of the "curvature" of time and of space. Remember what this "curvature" is. It is merely the measure of the degree to which clocks and yardsticks change as we go from one part of the space-time universe to another part of it. This means, of course, a curvature of time plus a curvature of space. Consider for a moment only the curvature of space in a curved universe. We have seen already in the first article of this series, that curved space may be finite, and yet unlimited.

If we could be absolutely sure of a correct value for the shift of the hydrogen lines and thereby of the exact amount by which star-time differs from earth-time, we could calculate the exact "curvature" of the universe, just as a man with a precise level can calculate the curvature of the earth. This calculation has been attempted recently in a series of papers by Dr. Ludvik Silberstein. Applying all possible corrections and qualifications, he obtains a figure for the "radius of curvature" of the universe of approximately 6,000,000,000,000 times the distance from the earth to the sun, or almost 10,000,000 light years. The "size" of the universe might be set down, therefore, as twice this value, being analogous to a diameter.

Spectrum Lines Actually Shift

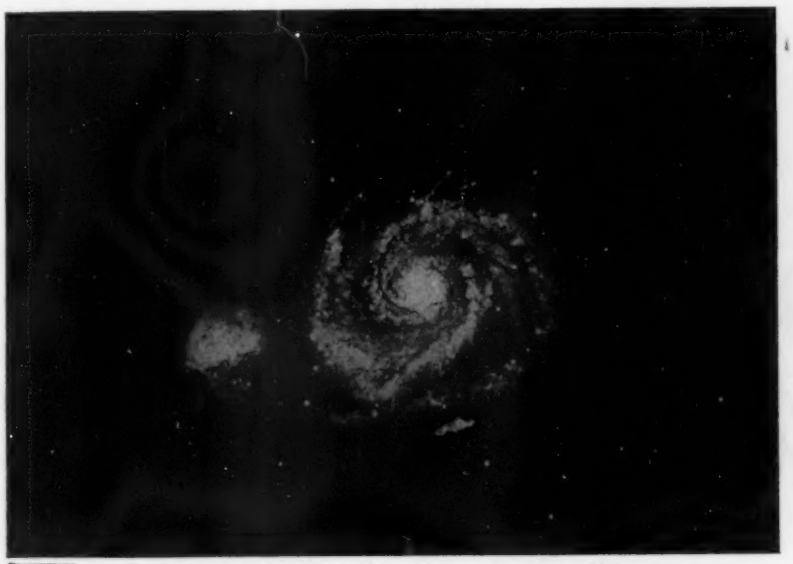
It is not to be imagined, however, that this is a definite and proved value for the distance across the universe that we live in. One must distinguish very carefully between the theoretical reasoning which indicates the *possibility* of an alteration of space and time equivalent to such a curvature of space-time and the supposed experimental fact that such a curvature actually does exist and has such and such a numerical value. The calculations of Dr. Silberstein, careful and ingenious as they are, rest on data which are far from certain.

We are in much the same position with regard to measuring the size of the universe as men were when they first began to suspect the roundness of the earth. They observed that the idea of its being round fitted quite well into what they knew of nature. They felt sure that if they had more precise instruments and knew better how to use them, it might be possible to measure the variations of the level with sufficient accuracy to prove that the earth is round and to get an accurate idea of how much it is curved. In time these instruments were invented, these measurements were made.

Men actually did determine the exact curvature of the earth.

What Exists Outside This Universe?

In his article next month—the fourth of this remarkable series on the Real Nature of the World—Dr. Rashevsky will discuss the possibility of a real boundary at the limit of the universe, as well as what, if anything, exists outside this limited universe; "beyond time and outside of space."



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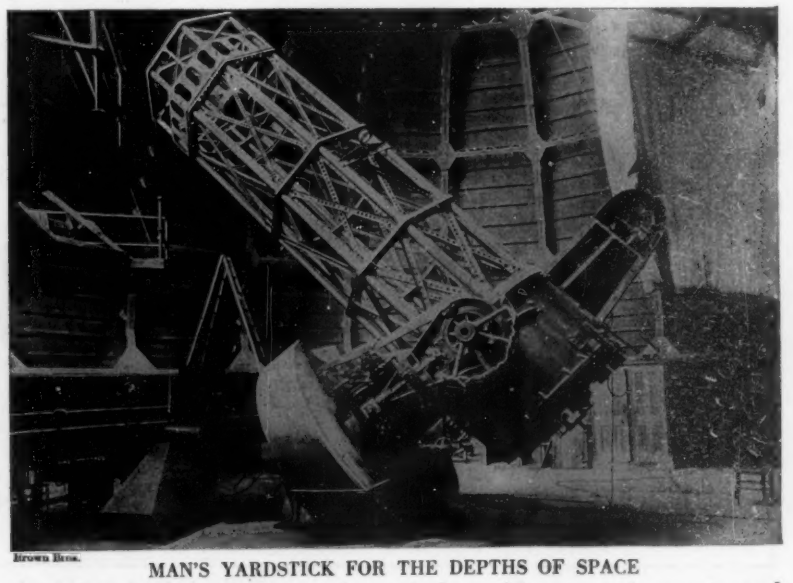
DISTANT WORLDS STILL PUZZLE ASTRONOMERS

Are these vast spiral nebulae other universes, far off in the depths of space, or are they objects inside our own universe? Astronomers do not know



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MAN'S YARDSTICK FOR THE DEPTHS OF SPACE

Attached to this sixty-inch reflector telescope is the special spectroscopic apparatus used at Mt. Wilson Observatory, California, to study starlight

Jewels in the Eyes of Insects

Some Marvelous and Brilliant Optical Devices of Nature's Making

By S. F. Aaron
Lincoln University, Pa.

CONTRARY to popular opinion the most beautiful objects with regard to color are not of mineral substance, however more durable and therefore valuable these are for ornamentation. And likewise the most gorgeous hues are not to be found in mineral or vegetable pigments or extractions, nor are they seen in flowers, the feathers of tropical birds, the corrugated surfaces of sea shells, nor even in the spring and autumn skies.

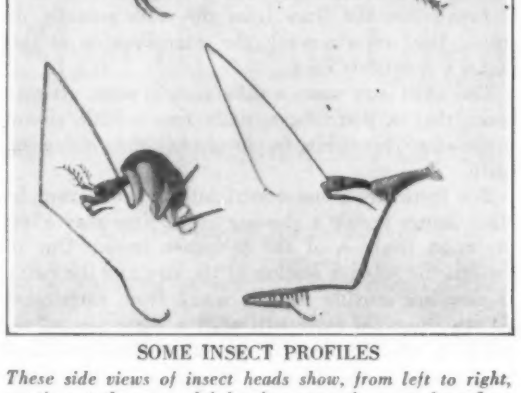
It is in the eyes of insects that the most exquisite colorations, in purity, depth or iridescence are to be observed. To many this is a surprising and no doubt questionable statement, but to the student it becomes a ready certainty. He has but to use his magnifying glass upon the eyes of a small number of varied insect forms. No glinting diamond, ruby, emerald, opal or pearl can convey to the human eye such brilliance or perfect blendings of widely contrasting colors as are carried about by certain two-winged flies, dragonflies, butterflies and grasshoppers.

Particularly is this true of that family of insects commonly known as horseflies, deerflies and green-headed flies. Some members of this group have eyes that are merely brown or black; in others the emerald tints with every combination of iridescent reflections are notable. The bad-smelling, green lace-winged flies, and some few species of the broad-winged dragonflies, give also splendid examples of the chitinous insect crust throwing off varied lights to rival the glints from fire or the sun itself.

A word to the doubter: Take a fly swatter and with a well directed, swift but not too savage blow capture a kicking, helpless deerfly or one of the typical green-heads while it is busy seeking or sucking the blood of horses or cattle, or perhaps of the deserving student himself. Then put the specimen under a pocket magnifying glass and gaze entranced at those delicately checkered surfaces that cover most of the creature's head on each side. Emerald green and blue predominate with glints of scarlet and the yellow of the golden reflections intermingling.

If these brilliant eyes of insects could be made permanent—kept from fading or from destruction by insect pests and sufficiently resistant to withstand even as much as a pearl withstands, the lovers of gems would turn to them above all else, for though small they could be multiplied.

As far as is known eyes serve the six-legged insects generally—and also their eight or more-legged relatives comprising the other groups of the Arthropods—as a means of protection against the approach of enemies. That must be the sole reason for the wide area and the numerous facets of the compound eyes, covering in most species the larger portion of the head.



SOME INSECT PROFILES

These side views of insect heads show, from left to right, starting at the upper left-hand corner; the great horsefly—the giant dragonfly—the admiral butterfly—the yellow jacket wasp—the crane fly—the stilt bug

Facing directly forward, upward, laterally and also to the rear the facts record movement at any angle and this explains the difficulty of approaching butterflies, moths, dragonflies, flies, grasshoppers, many beetles and wasps from any direction.

Though the optical construction and relative power of insect eyes might be a subject of profitable study, it seems to have rather escaped in its entirety most of the invertebrate anatomists and the nature students. How images are received and recorded, to what extent distorted and in what manner influenced by the amount of light and color, we have failed to perceive. We can get at some of this roughly, by observing the behavior of species with regard to the identification of friends and enemies, though in so doing there must be a careful consideration of the influence of odors, for the power of smell is the most highly developed sense with the most varied and certain uses that insects possess.

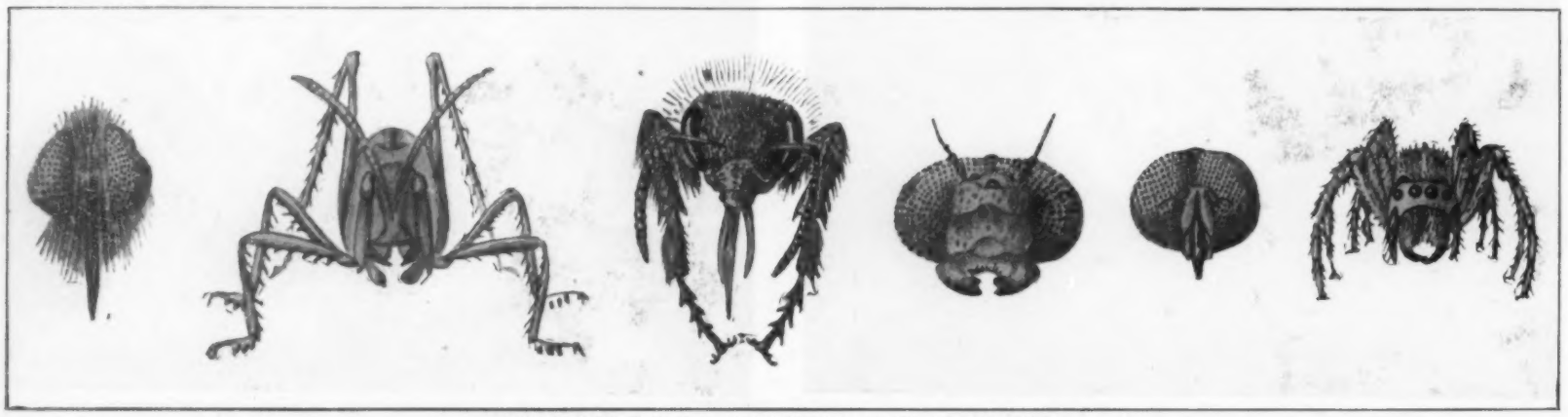
Anatomical examination yields but little in the comparison of insects' eyes. The eyes of a bee and ant not only appear alike externally, but they are apparently similar in the nerve attachments, yet an ant is almost blind, depending upon its eyes hardly at all, while the eyes of a bee afford considerable aid in the creature's recognition of friends and enemies.

The nervous construction of the eyes of all insects is on the same plan, the only difference being in the relative size as best compared between an assassin bug and a dragonfly. With hardly an exception among all of the six-legged orders, the eyes are compound; that is, they are formed of a large number of facets, there being as many as eleven thousand in one eye of the dragonfly and as few as three hundred in those of certain Hemiptera.

The external surface of the compound insect eye is made up of rows of groove-like indentations, commonly termed sutures, with each facet between these criss-cross rows, the facets being generally quadrangular with the indentations on each side. They also vary in size, those in the dragonflies, being large enough to afford easy observation through a compound pocket lens of three diameters, while others are so small as to defy detection by such means, requiring a microscope of at least fifteen diameters.

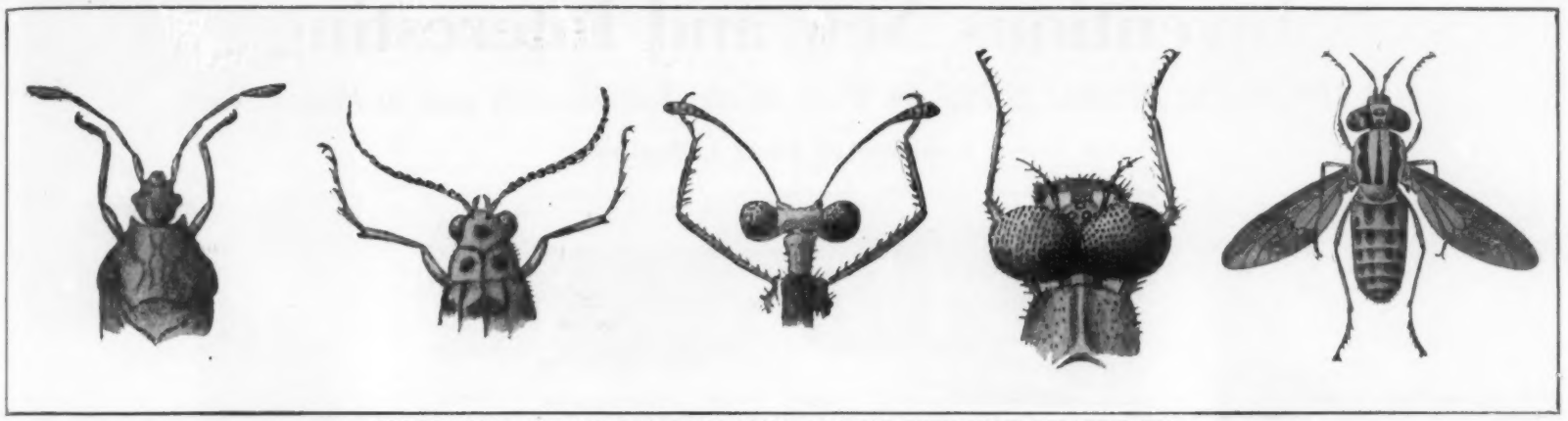
A great many insects, those belonging to most of the orders, possess also simple eyes not made up of separate facets. These are generally three in number grouped closely together about the center of the head; they are called ocelli. Some duty they perform more than that of the compound eyes. As compared with the simple eyes of spiders they must be functional; that much may be asserted.

The writer captured a dragonfly, placed it in a window where a quick motion of an easily visible object would cause it to flutter. The compound eyes were then covered with black opaque paint, the ocelli left open and other motions many times re-



SOME INSECT FACES ARE MOSTLY MADE UP OF EYES

From left to right the faces are: the robberfly—the grasshopper—the humble bee—the giant dragonfly—the sweat bee fly and the jumping spider with six of his eye showing



THESE HEADS ARE ALL DRAWN TO SCALE SO THAT THEY SHOW RELATIVE SIZES

Starting at the left they are: the giant dragonfly—the ant lion fly—the bella moth—the squash bug. The fifth drawing shows a green-head fly. Its eyes are golden emerald with spots of deep blue and with orange scarlet reflections. This insect is about three-eighths of an inch long. Allied species are an inch long with eyes as large as one-carat diamonds

peated caused the insect to become frightened. The ocelli were then covered also and the dragonfly, evidently totally blind, showed no fear, nor could it distinguish the light. When the sight was restored by washing off the paint the conditions were as before.

Very interesting, especially to the anatomist, is the nearly or quite transparent film or thin layer of nerve tissue that coats the inner surface of the insect eye shell which is merely a thin crust, convex externally. When the eye is cut open and this nerve coat is removed the facets show as plainly inside of the shell as on the outside. This film of nerve serves not only as a diffusive substance, but it must carry to the central spinal ganglia or insect brain, if it can be so called, the impressions of light given on the facets.

Some comparative anatomists have asserted that this eye nerve film is the insect brain, but that is an error. Carefully removed from within the eyes of a monarch butterfly, the nerve attachments to the antennae and to the proboscis being untouched, the imprisoned creature was able to ascertain the position of and go to a drop of honey and partake thereof. There was not the slightest indication that the insect could see.

When observing the habits of insects their very limited powers of sight become apparent. The susceptibilities to light and movement and the distinguishing of light and dark shades of any colors is evident; there is also a necessary recognition of certain objects by many of the more highly developed species.

Quality of brain also enters into the art of seeing, observable in all kinds of animals. If you are clad in dead leaf brown and stand motionless in the thick woods a woodchuck, opossum, rabbit or squirrel will approach down wind and pass by within a few feet, but a raccoon, mink, weasel, fox, dog or cat, domestic or wild, will see you, stop and eye you a moment and then make off.

This illustrates a comparative faculty which some humans have developed to a far finer degree than others: it may be called an eye for form. Many birds, as the hawks, have it finely developed; others so little that they will mistake a human being for a tree trunk. Insects possess it not at all regarding larger objects; to what extent some of them have it for objects nearer their size is largely problematical.

A robberfly will watch with eagerness the approach of an insect victim to within ten or twelve inches and then pounce upon it. A long fine wire or twig poked at it so that it sees only the end gives it no concern until in contact; then it merely flies away. But a dead specimen, a roughly fabricated paper insect, or a bunched black feather may each in turn be placed on a fine wire and thrust near the robberfly so that the bloodthirsty fellow will be fooled completely. The object is pounced upon instantly and as suddenly released, the sense of smell at close quarters or perhaps of touch putting the assassin wise.

Are the visitors to honeyed flowers guided chiefly by sight or by smell? There is abundant evidence that both senses play a part, but to what extent the eyes are a guide is difficult to determine. Honeyed blossoms as green as the leaves seem to be as much of a lure and as unerringly reached as the wide petaled blooms of brilliant colors, though it is pretty certain that butterflies, moths, beetles, bees and certain hornets do not go to the obscure flowers as readily as to the others. A bee will dash toward the large yellow tulip-like flowers of squash and drop at once into them, but go buzzing about in search of and pass over many of the green flowers of mulberry, hackberry or osage orange. Perhaps there is a difference in the intensity of the odor cast off, but from the way these inconspicuous blossoms are sought by hordes of honey seekers and at great distances there is abundant reason to believe they endeavor to make up in sweetness what they lack in beauty. Probably the more certain means of obtaining cross fertilization has determined the development of conspicuous flowers and the kind of color is a matter of some other influence or of chance.

WHEN THE SPIDER QUITS

The larva of a ladybird beetle pursues its course. The spider, discerning the nature of its foe, retreats

Further evidence that different shades of color are not readily perceptible by insects is seen in the courtship between butterflies. It has been suggested that the common yellow sulphur species recognizes the yellow color of its mate. But any wandering lothario among these denizens of the air will flutter eagerly about another of any color or sex that comes near enough until that other and more powerful sense directs it. The yellow sulphur and the white cabbage butterflies will fraternize thus and part quickly, not because of the difference in color, for there is a dimorphic female form of the sulphur butterfly that is white.

Further evidence of insects being able to tell the form and character of friend or foe is given by the tiger beetle. These killers will run near and past any small yellow, white or red butterfly sucking the juices from a muddy road and will pounce upon an Agrion dragonfly, a waterfly or caddisfly of a similar size. They will give a mud dauber, digger wasp or burrowing bee a wide berth of many inches and sneak up to and leap at a bluebottle fly. Choice is made with such accuracy and so quickly that there can be no question that it is a matter of sight only.

A reverse parallel instance is to be found with ants. As has been said they have no powers of sight other than the barest influence of light and shadow, but they do have most excellent ability to detect odors. They will tackle anything: bee, wasp, spider, fly, moth, caterpillar and while they generally carry home the bacon they often fall victim to their inability to tell friend from foe. Does this not indicate that the scent organs are not infallible and that eyes must be relied upon?

Another example is afforded by the spiders, not true insects but which the entomologists very gladly include within the fascinating number that offer such varied examples of study. Watch a jumping spider wandering about in search of prey, which she does not take by lying in wait within a snare. A long and flat-bodied larva of a ladybird beetle approaches upon the weed stem; it is eagerly in search of aphids. The spider, probably well aware of the nature of the larva, faces it, but gives way at the distance of several inches, presently running around the stem until the ungainly crawler has passed by. A black ant comes along, also seeking aphids, but for a very different purpose; the spider takes one look with its eight eyes and takes to its eight heels in a hurry. A small blue-coated bee alights near attracted by the delectable odor of honey dew; the spider approaches, apparently examines and cogitates upon the get-up of this fellow and decides to let it alone. A blue or green or black or yellow-bodied fly, by no means objecting to the nearby sweets, alights on the weed stem and the spider does the feline act to perfection, sneaking up most cautiously and suddenly leaping at or upon its victim.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

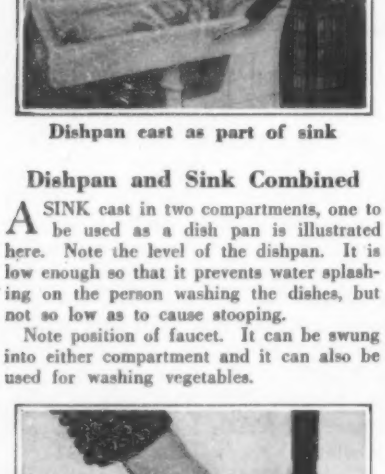
Conducted by Albert A. Hopkins

Dishpan cast as part of sink

Dishpan and Sink Combined

A SINK cast in two compartments, one to be used as a dish pan is illustrated here. Note the level of the dishpan. It is low enough so that it prevents water splashing on the person washing the dishes, but not so low as to cause stooping.

Note position of faucet. It can be swung into either compartment and it can also be used for washing vegetables.



The mop head pictured here can be removed for washing quickly and easily. It is so made that it is run on the angle-shaped wire of the mop in the same manner that a curtain is run on a curtain rod

Broadway Signs Barred in Paris Under Old Law

A LAW handed down from the time of Napoleon is being invoked to save Paris from Broadway advertising methods. The Prefect of Police dug up an ancient statute that gives him jurisdiction over the exterior design of buildings in the vicinity of any particularly interesting sculpture or spot which under French law may be classified as "historical monuments." So the opera vicinity may never rival the dazzling brilliancy of Broadway.

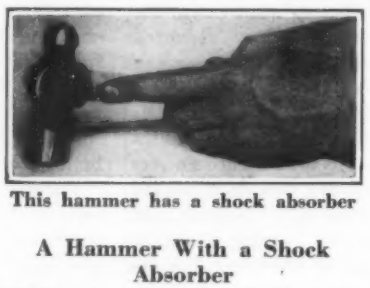
The last time we visited Paris we were struck with the dullness of the illuminations quite different from London which was exceedingly gay.

A steel moving van protects household goods against fire

Steel Moving Van Foils Fire

A NEW steel moving van, hauled by a farm tractor equipped with pneumatic tires is pictured on this page. This van is being used in California and hauls household goods from one city to another.

When a stop is required over night, and storage in a public garage is necessary, the householder's goods is protected against fire.



This hammer has a shock absorber

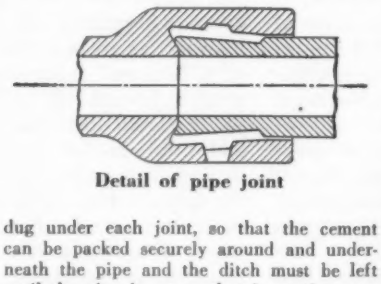
A Hammer With a Shock Absorber

THE ball pein hammer illustrated here has a shock absorber incorporated in it. Rubber is forced in with the wooden handle until it forms the rubber ring the hand is pointing to.

This rubber ring serves as a shock absorber and breaks the constant vibration when the hammer is in use. It also makes the handle more secure in the hammer head. Hammer accidents occur in nearly every shop and it really seems as though they are unnecessary if adequate inspection is made.

Invisible Interior-filled Pipe Joint

THE joint pictured here provides an internal and invisible joint for standard bell and spigot-end pipes. It does away with the big ring of binding material usually wiped on the outside of the pipe. A great disadvantage of wiping the joint on the outside is that large ditches have to be



Detail of pipe joint

dug under each joint, so that the cement can be packed securely around and underneath the pipe and the ditch must be left until the pipe is set so that inspection may be made.

No skilled labor is required to lay the pipe and contractors have found that pipe can be laid with more speed than with the ordinary plan. The composition of the filler can be changed. One formula is one part of cement and two parts sand.

Considerable loss of concrete is eliminated because the cement has a tendency to fall off on the under side of the pipe. This new device obviates this loss.

Pipe, having the invisible interior-filled pipe joint, tested to destruction

It toasts, roasts, cooks or bakes

It Toasts, Roasts, Cooks or Bakes

A NEAT and clever little cooking utensil for the kitchenetter is the light-weight, round oven illustrated here. It can be used for toasting, roasting, cooking or baking. It is especially recommended for campers.

The patented interior arrangement produces an intense concentrated heat having a thermo moisture effect said not to be obtained in larger ovens.

The wire rack illustrated can be used in two ways—as shown, or standing on the handles for baking purposes.

Device for sharpening scissor blades

Quickly Sharpens Scissors Blades

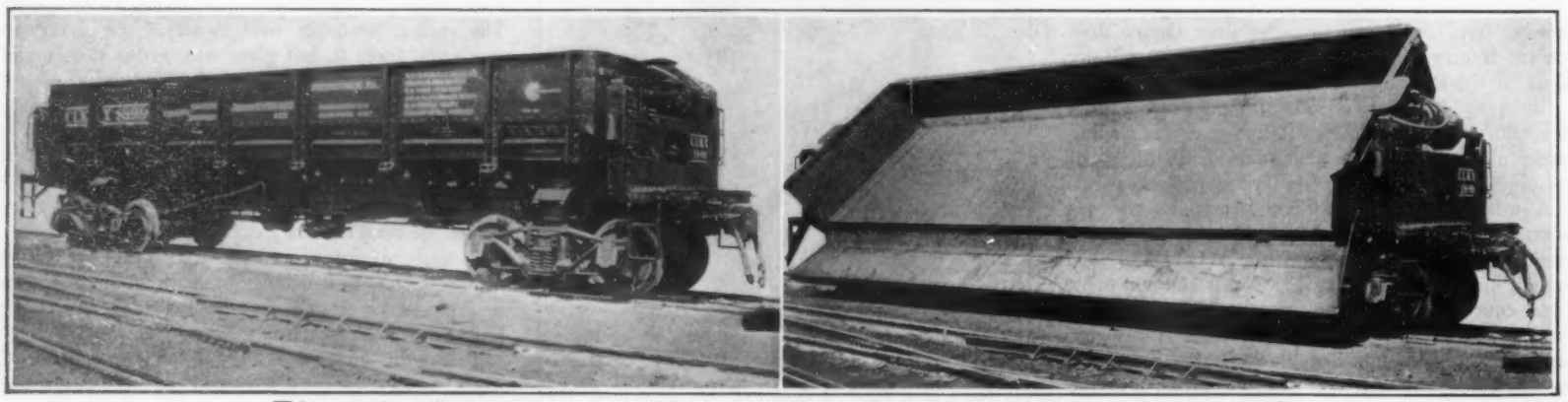
A SIMPLE, manually operated machine, illustrated here, quickly sharpens blades of shears, scissors and so on. Adjustments are provided on it by means of which the abrasive used can be operated at several different angles.

The machine provides an arrangement for clamping the blades in a fixed position, thus securely holding the point of the blades and insuring an even and accurate sharpening.

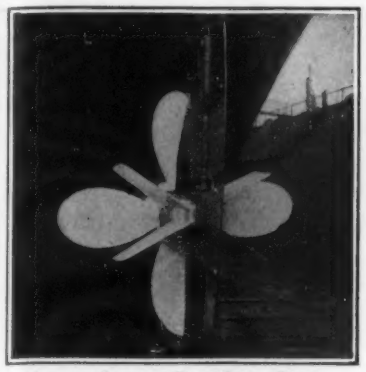
We have plenty of devices for sharpening knives, razor blades, etc., but the scissors sharpener seems to have been neglected.

New Type of Dump Car

THE operation of this dump car will be readily understood by a reference to the illustration. The car shown has a capacity of 30 cubic yards, level, 43 yards normal loading, 100,000 pounds.



This extension side dump car is operated by compressed air and the whole side of the car moves outwardly



A novel propeller that effects economy

A Contrapropeller That Saves Power

A GREAT deal of power is wasted in the case of the ordinary screw propeller through imparting motions to the water in directions where they do not do any good. It is obvious to anyone that water is thrown off tangentially, for instance. In addition, it is given an axial "twist." To prevent the former, as far as possible, experiments have been made with thin rings fitted around the tips of the blades of the propeller. To prevent, in some measure, the latter, the American steamer *Norfolk* was fitted with a device known as the contrapropeller, which we illustrate. The contrapropeller consists of six blades of cast iron, thin and appropriately curved to break up this twist of the water, giving the propeller blades something to push against, as it were.

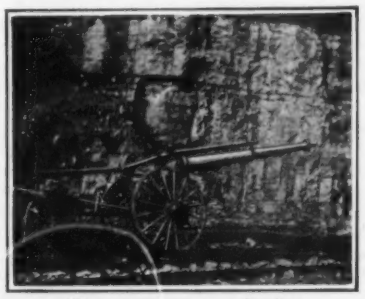
Evidently the contrapropeller accomplished what it is designed to accomplish, for tests made on the *S.S. Norfolk* indicate about a nine percent increase in speed and a fifteen percent decrease in coal consumption. Further than this, the device produced a marked improvement in steering ability. Of the six blades mentioned, but four seem to show in the illustration, but the remaining two, the vertical ones, are welded, electrically, direct to the stern frame. Only the upper one of the two shows for the lower one curves in the direction that causes the stern frame to eclipse it.

It is said that this device has met with success in Europe as well as in the case of the American ship named.

The Monitor on Wheels

THE monitor is the name of a giant nozzle, made familiar because of its use in hydraulic gold and platinum mining. The gravels known to contain these metals in nuggets is washed from the banks and into sluices, where its recovery is simple. The same instrument is used by a limestone company of the Greer Limestone Company, Greer, West Virginia, for the purpose of removing the overburden of clay and sand from the rock that is about to be quarried. This equipment takes the place of a large gang of men doing hand shoveling, or of a steam shovel; and it costs less money to operate than either.

The water for this monitor is derived from a three-stage six-inch centrifugal pump, driven by a seventy-five horsepower motor, which gives a head at the nozzle of 175 pounds a square inch. The distinctive feature, however, is the mounting. Monitors are usually given a more or less stationary mounting, for the reaction or "kick" from them is powerful. The use of wheels is made relatively possible because of the rather low pressures in hydraulic mining here employed, as the wheel truck permits the outfit to be moved about at will.



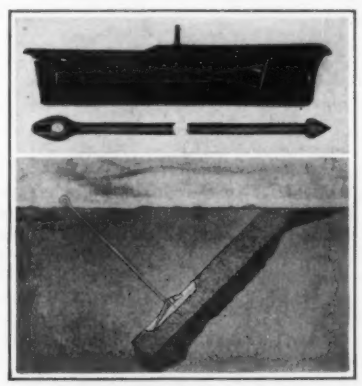
The monitor on wheels

The power behind a flying column of water is extremely great, as is illustrated by a favorite trick which hydraulic miners often play on greenhorns. The greenhorn is led —or misled—to believe that cutting down through the stream with an axe, as it issues from the nozzle would be possible only for a good axman. He is warned to hold the axe very tightly, however; with the result, which is invariable, that axe, greenhorn and all are hurled several yards into space. The water issues, under the high pressures commonly used in this work, at altogether too high a velocity for the quickest stroke to pass through it without lateral motion enough to hurl the axe with the water. In fact, arms have been broken in playing this practical joke.

By removing the cork in the end of this glass mucilage moistener, water is poured into the bottle. A felt stopper keeps water from running out, but it is kept moistened sufficiently for wetting stamps, labels and so on

The Cast Iron "Dead-man"

TELEPHONE poles and other kinds of poles, smokestacks, ginpoles and, in short, many other things that stand up in the air, often need guying. Burying a dead-man is the best method of doing this, since the holding power of a stake driven into the earth is not high and stakes are "tricky," drawing out of apparently solid ground when needed the most.



A cast iron "dead-man"

When you dig a pit and bury a dead-man, if you shape the hole right and place the dead-man in the right position, its holding power is surprisingly great. It is pulling against, not merely the earth directly in front of it, but a whole cone of earth weighing many tons, and in addition pulling against the cohesion of this earth. But the pull should be against undisturbed ground, and the correct placing of the dead-man often involves the excavation of a lot of material.

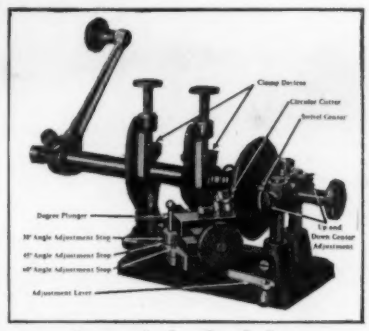
A Centralia, Missouri, manufacturer has put on the market a prepared dead-man or anchor which may be used in a comparatively small hole. A hole is drilled for the anchor plate with an augur, the anchor rod is driven through the solid earth at right angles to the augur hole and the anchor plate is hooked on. Thus, the pole or other object is anchored to solid, undisturbed earth. It cannot skid because the disturbed earth which permits its insertion is so limited in extent. Being made of metal, it cannot rot away.

The anchor rod is especially equipped with a driving point, permitting it to penetrate the earth easily, and this point is so designed that it locks in the plate without any nut or pin.

A Practical Valve

VALVES that appear to need regrinding often stand in still greater need of retruing. Stems often warp under the intense heat of heavy duty, and throw the head of the valve out of square. Better than almost any amount of grinding is the taking off of a thin shaving from the part or side that is eccentric. This may be done in a lathe, but most people do not have a lathe.

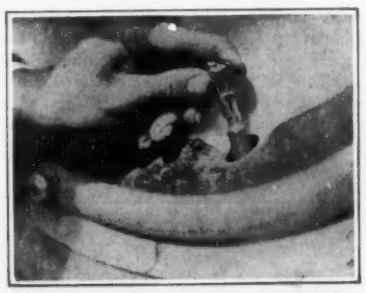
In cases like this the little valve lathe illustrated on this page is a boon. You simply clamp the valve under the two clamp devices, set the cutting tool to the angle required by your valve and give the handle a turn or two. It is not a long job, for the tool cuts rapidly and when the eccentricity has been removed and the valve is true no further removal of metal can get it any truer.



A practical valve lathe

This little tool is really practical and is so small and inexpensive that not only the garage repair man, but the average man who likes to do his own repairing might well have one around the shop. Any valve from 1⅜ inches to 4⅛ inches, and having 30, 45 and 60 degree angle, may be refaced in it. It fastens permanently to the bench, or may be put away when not in use and put in a vise when in use.

This little implement, which is made by a Sioux City manufacturer, has saved a large amount of "elbow grease" and temper, and will no doubt continue to do so.



This device lets the air out of the tire tube

A Device That Lets the Air Out of the Tube

WHEN this device is clamped to the valve stem of an automobile tire by a slight press of the thumb and finger a small pin in the center compresses the valve spring so that the air escapes.

Returns Aboard the "Century"

ELECTION returns were given passengers on the Twentieth Century Limited. The powerful receiving set was placed in the observation car.

Combined elevator and fire door

A Safety Device in Case of Fire

THIS device shows a development of combined elevator door and fire door believed to be of special interest. You will note that the fire door is set flush with the inside wall of the elevator well and presents an even surface with the same. There are no projections of threshold, door nor fixtures. The small pin with which the operator opens the door is carried on the elevator car. When not in use, the car is kept at the bottom floor and the doors at this point are equipped for locking on the outside with a lock and key. As the doors above can be opened only from the inside the danger of anyone falling into the well is eliminated, as is also the hazard of opening the door from the outside while the car is in motion.

10,699 Advertising Signs Here Burn 1,095,841 Incandescents

WHEN you step into the artificial sunlight of the Great White Way and the lesser ways of New York you step into the radiance of more than a million incandescent lamps in 10,000 electric advertising displays.

Of the 10,699 signs in Manhattan, 2,130 mark the location of restaurants and 809 more are those of tobacconists. Theaters have 477 signs and undertakers eighteen. The count of the Edison Company shows that 1,095,841 lamps are used, of which 983,485 are of the smallest size, ten watt.

Novel Screen for Motorists Has Many Advantages Over Goggles

A NOVEL screen for motorists can be fitted to any cap, and gives the wearer more freedom, as it does not come in contact with the face. Spectacles can be worn, they will not foul the screen.

The material used is non-inflammable, and highly transparent. Owing to the comparatively large clearance between face and screen, perfect ventilation is insured, and a clear view in every direction is possible, without turning the head.

When not needed, the screen is put out of the way by pushing it above the cap. Special clips secure the screen to the peak of the cap.

This motorist's screen fits any cap

The compass ring has its uses

A Compass Ring

THERE are many kinds of rings and many kinds of stones, but perhaps the most novel one which has come to our attention is a finger ring set with a compass in place of a stone.

The many advantages of a ring of this nature can readily be seen when used by the electrician where high voltage lines are to be tested or where armatures and stators in motors and generators have to be examined and their polarity determined.

It is not only very useful but a neat looking ring which can be worn at any time.

Inexpensive Knuckle Guards

THE other day the writer was in a large machine-tool works in Providence, R. I., where "Safety" is regarded of the greatest importance. In the foundry all the wheelbarrows had projecting knuckle guards which prevented the workmen's knuckles from being injured in passing through doorways or gates. This device is so cheap and efficient that it is a wonder that every wheelbarrow in the land is not so equipped.

Projecting knuckle guards protect workmens' hands

A Group of Kitchen Utensils

THIS group may present few objects with which the reader is not already familiar, but possibly all our readers may not be acquainted with all of them. On the two ends will be found very useful members of the grater family. On the left, is one shaped like a cow bell and presenting surfaces with different punchings so as to give the usefulness of four graters. The folding grater on the right-hand end also has a plurality of grating surfaces, and has the advantage of folding up.

The egg-beater in the center speaks for itself. The average department store can supply at least a dozen different egg beaters. The one shown is rapid and runs easily. In the left foreground there is a strawberry huller which saves the fingers from stains. Next, is an egg separator adapted to separate the white from the yolk, not always an easy process. Then we have a useful kitchen tool, called, we believe, a "slicer," and lastly an egg tong or holder to manipulate a hot egg.

Everlasting Bronze Socket Holds "Eternal Light" Aloft

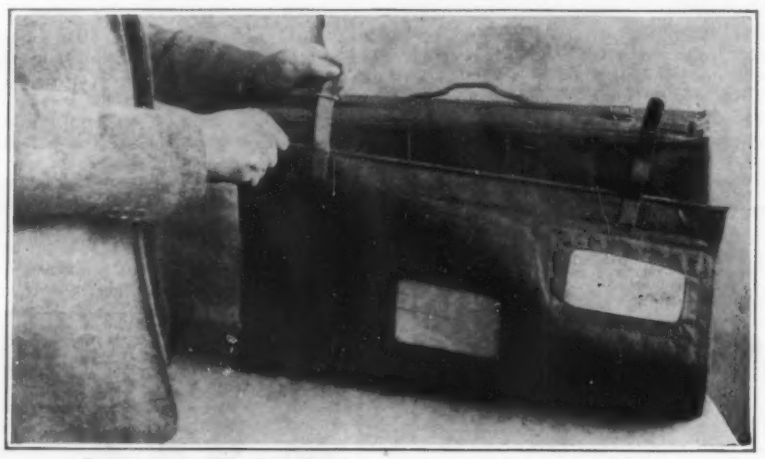
AN "Eternal Light," dedicated to those who died on the battlefields of the late war, shines unceasingly in New York's Madison Square Park. The memorial was given to the city by Mr. Rodman Wanamaker and has been erected on the spot where the city in 1918 greeted the first of the returning World War veterans.

A solid bronze socket, probably the world's largest candlestick, holds aloft the everburning taper. This huge candlestick is molded in a single block of bronze and its weight of 1,500 pounds rests upon a marble base.

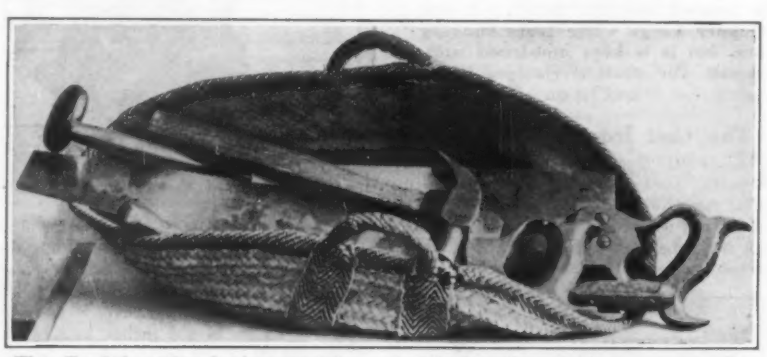
New York's "Eternal Light" is akin to the French memorial, known as the "Perpetual Flame," which burns beneath the Arc de Triomphe, in Paris. The "Perpetual Flame" burns in a brazier which is refueled each day at five o'clock by a representative of some patriotic or civic organization. The American memorial is electrically lighted and its circuits have been so arranged that in the failure of one to operate, automatically another will function, thus forever perpetuating the memory of our fallen heroes.

A Safe and Economical Way to Ship the Laundry Home

LAUNDRIES in college towns are notoriously high in price, and many students feel the burden and yearn to send their laundry home where the cost is lower, or where it can be done for nothing. The ordinary laundry bag is impossible for mailing and cardboard boxes likewise. One manufacturer at least has seized on the idea of making a mailable package, so that laundry may be shipped by parcel post with safety and economy. An outside covering serves to protect the package and proper windows have been left for the address of shipper and consignee.



It is easy to ship laundry by parcel post with a bag like this

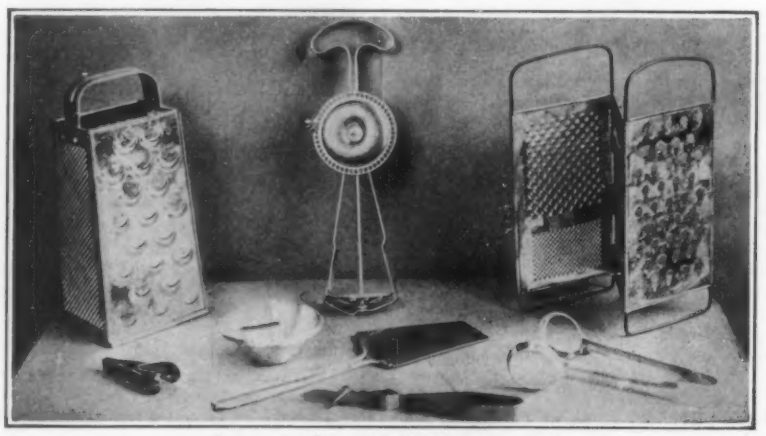


This English utility basket used for a hundred and one things can now be had in most New York department stores

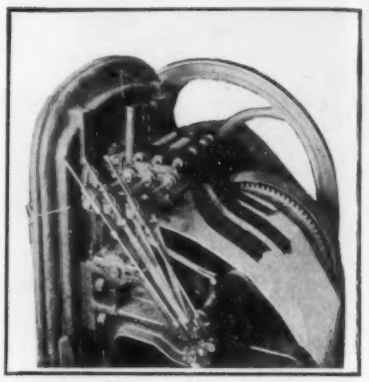
To Preserve Watt's Garret

NEGOTIATIONS are expected to be completed shortly whereby the garret in Heathfield Hall, Handsworth, in which James Watt conducted the experiments which led to the development of the steam engine, will be brought bodily to London for the Science Museum.

Watt first went to Heathfield Hall in 1768. After his death the room in which he worked remained locked. It is interesting to know that this relic will be preserved.



A group of useful kitchen utensils



A device that can be attached to an upright stamping press for feeding roll gold leaf

Feeding Roll Gold Leaf

AN ingenious and simple device that can be attached to any make of upright stamping press is being put out by a New York concern. This device is for feeding roll leaf. It not only speeds up production and saves in labor, but affords an added saving in leaf, as the machine feeds rolls the exact width of the impression, with only a fraction of an inch each side of the stamp.

The leaf, which is placed on the rolls, is pulled by rollers from the rear of the press, which operate from the camshaft. Rolls of various width can be put on any of the rods. The leaf runs from the rods under a long spring the width of the head, and then under the head of the press and is placed between the rollers in the back of the press, which do the pulling. The clutch mechanism is operated from the camshaft of the press. The whole arrangement allows for the attachment to stand still while the platen is not in operation.

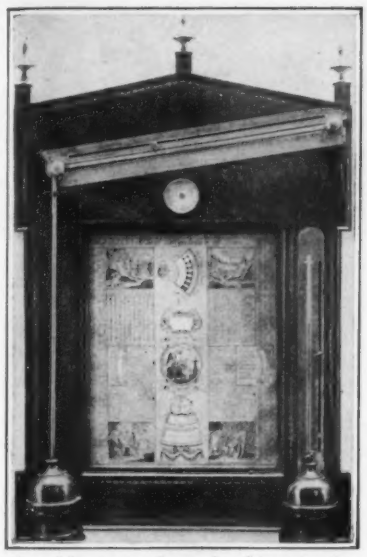
Removing the stains of travel with a baby vacuum cleaner

The Car Vacuum Cleaner Removes Travel Stains

THE days of riding in a closed car on dusty upholstery will soon be a thing of the past if the auto vacuum cleaner continues to gain in popularity.

By simply slipping the rubber tubing on the valve while your motor is running slowly, and then opening the valve, you are ready to clean with it. The auto vacuum cleaner is installed right on the motor. The suction, which is procured from the intake on the motor, the same as the feed, is taken through a chamois skin, thus eliminating any chance of dust getting in to the motor.

The equipment consists of ten feet of loom-covered rubber tubing and an aluminum cleaning nozzle. The couplings are of the compression type, while the nickeled shut-off valve can be mounted on the instrument board or any other convenient location. When the nozzle handle is full of dirt, the shut-off valve is closed and the nozzle pulled off and emptied.



An old meteorological cabinet in the Metropolitan Museum of Art

A Power Folder for Sheet Metal

A UNIQUE power folder and brake has recently been put on the market. This folder has a working length of seventy-two inches, for a Number 14 gage sheet metal and lighter.

A sheet can be bent to right angles at any distance from the edge, or a thirty-degree acute angle bend can be made along the edge of the sheet. Successive bends are made to form the sheet into closed bodies such as box or square pipe. This machine is especially adapted to the manufacture of ice cans, the folder making it possible to form the body of the can from a single sheet.

A bar provided with two gripping jaws acts as a handle and facilitates the feeding of the sheet into the folder. It is guided by grooves cut in steel blocks, which are adjustable along the gage brackets. The taper of the can is also taken care of by this method of gaging. The motion is controlled by a friction clutch actuated by a long foot treadle.

The drive is double-back geared. The clamping bar is a steel casting guided at both ends by large steel posts that move in brass-bushed bearings. The bar is automatically moved up and down by cams on the main shaft, the action being properly timed with the action of the folding bar.

Box pipe as small as eleven inches square can be formed from the flat sheet, and easily removed from the folder.

The Secret of Good Fishing Reels

THE fishing reel is not a large apparatus but it is a numerous one—and due to its wide use it is a fairly large consumer of copper products such as brass, bronze and nickel silver. Without these metals the efficient life of the reel would be short because rust soon would put it into the discard. Most fishermen know the good reels—successes for many years.

An examination of these reels will show that they are constructed practically throughout of copper products. Another case of quality materials playing their part in the success of manufactured articles.

Corrosion and Rust Cost $2,500,000,000 a Year in United States

BATTLING rust and corrosion costs approximately two and a half billion dollars a year, according to W. J. Overbeck, superintendent of the Du Pont Company of Chicago.

"This sum spent annually to counteract the ravages of corrosion and rust will give a fair idea of the total bill the world is paying for the slow decay of metals used in industrial work, which are not protected against them," he declared. "It is a vital matter because the yearly waste is making the iron-ore resources of the world exhaustible within a measurable distance of time."

A large amount of time is now being devoted to the problem of doing away with corrosion.

For Better Ventilating

COPPER ventilating ducts are now being used quite extensively. The ventilating systems of one of the large chain of restaurants in New York City contain five tons of copper. These systems are most efficient, keeping the restaurants well ventilated at all times, thus constituting an added attraction.

While at first glance this would seem a rather expensive proposition, the ultimate economy is assured by the lasting qualities of this metal. The material used throughout the systems is twenty-four-ounce copper. Our illustration shows the copper ventilating ducts which have been installed at one of the restaurants.

Hot Bread for the Diner

A NEW type of bread warmer has recently been introduced in the dining cars of one of our large railroads, which enables the traveler to enjoy hot bread with his meals whenever he so desires.

The carrier is made of copper, and of a size which can readily be brought to the table. A charcoal oven in the bottom of the container supplies the necessary heat, while a tray at the top holds the bread. This device will no doubt give added comfort to the man or woman who spends a great deal of time on the road.

Hot bread is supposed to be injurious to the stomach, yet many who eat it regularly live to a healthy old age, thus proving that theory and practice do not agree in this case.

Hot bread for the dining car is a greatly enjoyed luxury

Copper ventilating duct atop of a New York restaurant

A Portable Boring and Honing Machine

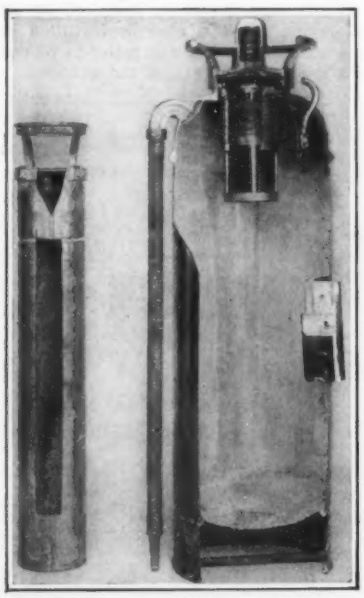
OWNERS of automobiles, tractors or gas engines will no doubt be interested in a portable cylinder boring and honing machine now being manufactured by a Cincinnati firm.

The "Cincinnati Borhonizing Machine," as it is called, is operated by a one-half horsepower electric motor attached to a light socket. It is designed to bore and hone cylinders from two and five-eighths inches to six inches in diameter to a depth of fifteen inches. The finished surface will have a mirror-like appearance and the performance of the engine will show a marked improvement with the least expenditure of fuel.

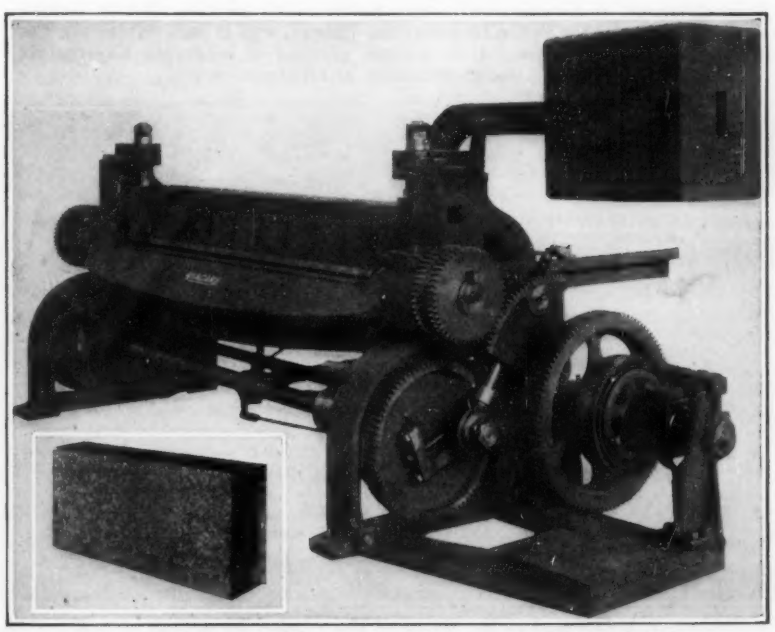
The machine is provided with a self-centering boring head, and the spindle is of high-grade steel measuring one and one-half inches in diameter. It is so constructed that it will handle cylinder blocks of all sizes and shapes, motorcycle blocks included.

The time required to finish four-cylinder blocks is one hour, six-cylinder blocks, one and one-half hours, and so on.

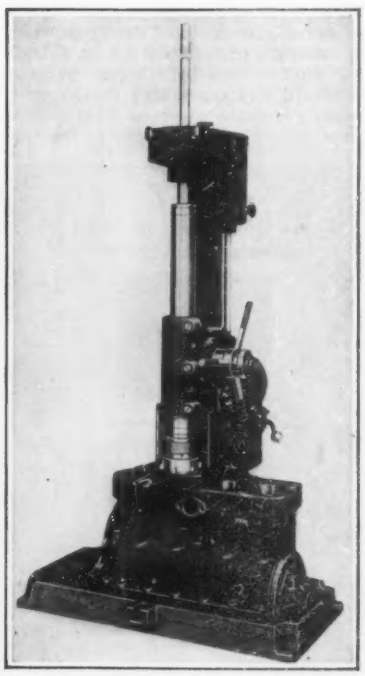
Units of this nature are now found in many automobile repair shops, even in small communities. They effect a great saving in time and make it possible to bring a cylinder, which piston slaps or other causes has worn out of round, back to geometrical accuracy. They soon pay for themselves.



Sectional view of two fire extinguishers showing in the larger one the position of the acid bottle



A power folder for sheet metal and a sample of its product



Cylinder borer and honer is called the Borhonizing Machine

In handling hot or dusty fruit jars this can lifter is especially useful. Simply slip the wire over the neck of the can or jar and lift by the handles

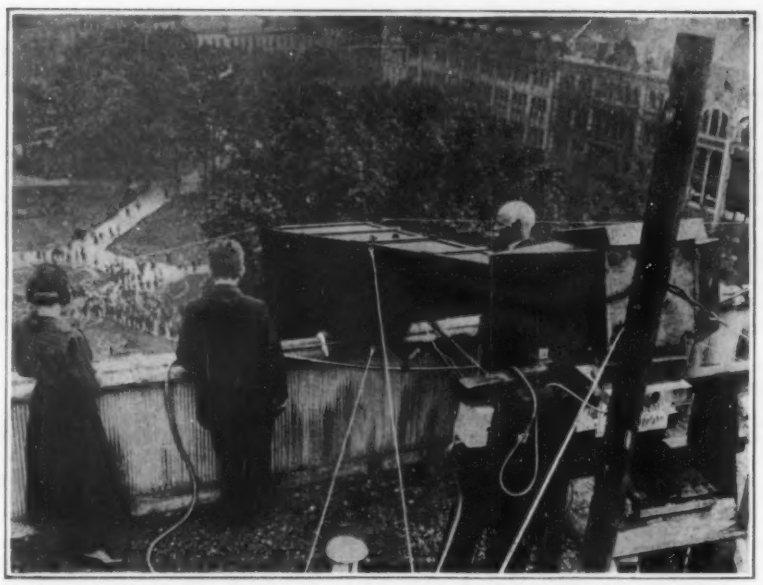
Tremendous Losses Caused by Abrasion

LOSSES by abrasion are an important item in the economy of human life. They are not confined to any particular branch of domestic or industrial activity. We know how rapidly shoe soles and clothes wear out, how floors, sidewalks and street pavements become rutted and defective by wear and tear, how frequently axles and tires of our vehicles must be renewed and, if we are observant enough, we may also know that gangs of men are almost constantly at work on our railways, street car, subway and elevated lines, removing worn out rails and replacing them with new steel rails. But few of us have a clear conception of the magnitude of the losses caused by ordinary every-day wear and tear.

In many cases it is practically impossible to establish a basis for even the roughest estimate. Dr. Harman, a British railway engineer, made an effort to calculate the loss caused by the wear and tear of the rails on the railways of the world. He collected data concerning the renewals of rails during an average year on railways in different parts of the world and concerning the losses of weight which the worn out rails showed, compared with their weight at the time when they were new. From the figures thus obtained he calculated that the quantity of steel removed by abrasion from the rails of the railways of the world is about 247,000 tons annually. This loss does not include the losses by the abrasion of the millions of wheels and brake-shoes.

The number of persons in the world who wear shoes of some kind is estimated at approximately 800 millions. According to careful calculations every person wears off at least one pound of leather from the soles of his shoes. The quantity of leather thus lost by abrasion in a single year would total 400,000 tons, a load that would require for its shipment eight of the biggest ships afloat.

Automobiles and other vehicles annually remove by abrasion from one-half to three-quarters of an inch from the surface of macadamized highways. City pavements of wooden blocks or asphalt offer greater resistance.



Berlin entertains the public with this huge loudspeaker mounted on top of a high building. A special license permits the owners of these loudspeakers to make as much noise as they wish

Epidactyloscope is a rather long name but it comes easy to Captain Golden of the New York City Police Identification Bureau, who is seen explaining the intricacies of the machine. It is for the purpose of enlarging fingerprints making the identification of criminals easy

A milk bottle cap with the milk record and order kept inside the cap the dial can be set for whatever the housekeeper needs — milk, butter, cream or eggs

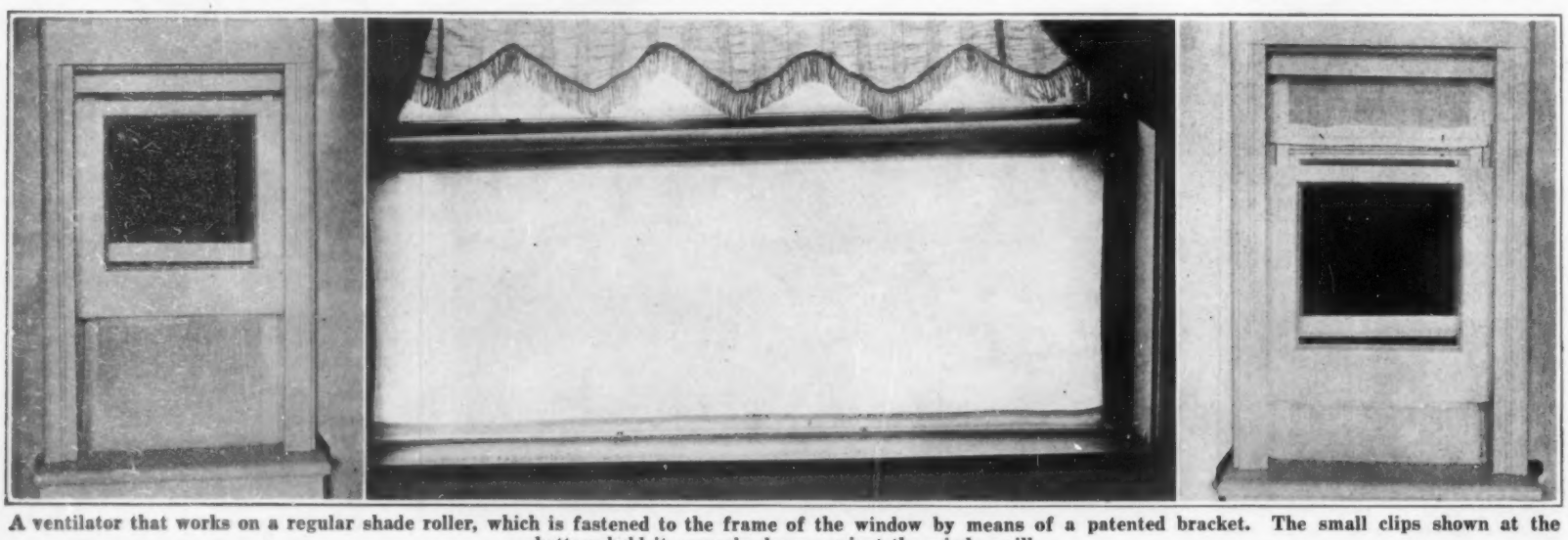
Ventilator Rolls With the Window

THIS new window ventilator rolls with the window. It will protect curtains from dirt, and a room from draft and dust, and can be extended the full height of the window.

It is made of a very fine piece of cotton material and works on a regular shade roller. This roller is secured to the frame of the window by means of a patented bracket. Small clips, seen at the bottom of the window, hold it securely down against the window sill.

This ventilator is also a burglar alarm because in order to enter the window, the material must be cut, when the roller upon which the ventilator is mounted will exhaust and pull the ventilator up with a loud bang.

Illustration shows it installed in an old house. It can also be installed in new buildings, when the roller is placed in a groove in the rail of the window.



A ventilator that works on a regular shade roller, which is fastened to the frame of the window by means of a patented bracket. The small clips shown at the bottom hold it securely down against the window sill

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.

Pertaining to Aeronautics

SELF-OPENING PARACHUTE.—So constructed and attached to the aviator, that it is not liable to foul with the airplane or dirigible when the user jumps. Patent 1509410. J. W. Ruff, 205 St. Philip St., Charleston, S. C.

AIRPLANE.—With auxiliary lifting means which permit the plane to rise from the ground in a minimum space. Patent 1510,317. M. Gold, 29 West 25th St., Bayonne, N. J.

Pertaining to Apparel

DOUBLE-LOCKING HOOK AND EYE.—Adapted for use in fastening garments in general, but more particularly leggings, galoshes and similar articles. Patent 1509002. W. C. Soule, Savannah, N. Y.

BELT RETAINER.—Adapted to be detachably secured to a garment for holding a belt against displacement. Patent 1510868. E. O. Sjolander, 706 Merchant St., Los Angeles, Calif.

BOUDOIR CAP—Wherein the elements comprising the same are assembled to form an openwork cap of attractive appearance. Patent 1512866. W. Strauss, 16 W. 22d St., New York, N. Y.

GARTER SOCK—Providing a combination sock and garter, which suspends the sock, by embracing the calf of the leg. Patent 1512876. L. Chanin, 35 Ocean Place, Brooklyn, N. Y.

HAT-SHAPE RETAINER—For mounting in soft hats to retain the creases and desired appearance. Patent 1512365. N. Rosen, 894 Irvine St., New York, N. Y.

Chemical Processes

PROCESS FOR THE PRODUCTION OF CYANIDES.—Which consists in heating a silicon nitride containing mass with iron carbide in the presence of sodium carbonate and absence of free carbon. Patent 1506269. F. von Bichowsky and J. Harthan, 1412 San Fernando Blvd., Glendale, Calif.

METHOD FOR THE LIXIVIATION OF MATERIALS.—Characterized by a feeding of the material upwardly in a diluted condition through particular channels in the screening. Patent 1509686. E. Morterud, c/o Bryns Patentkontor, Tostrupgaarden, Christiania, Norway.

Electrical Devices

ELECTRIC BOX.—Wherein the cable is firmly clamped against accidental displacement, yet may be quickly disengaged by hand. Patent 1508666. E. Niederman and M. J. Krinsky, 22 North Fish Ave., Winfield, N. Y.

RENEWABLE FUSE PLUG.—In which the fusible element consists in a unit which may be quickly and easily replaced. Patent 1508,402. S. Kubiak, R. R. No. 2, Fortville, Ind.

INSULATOR.—Wherein the wire can swing or have a curved passage without being subjected to wear or friction. Patent 1509074. J. L. Wilson, R. R. No. 1, Davenport, Iowa.

ELECTRIC MOTOR.—The stator of which may be removed and replaced without moving the motor from its mounting. Patent 1509813. J. M. Rodriguez, c/o John A. Harris, 954 E. 13th St., Brooklyn, N. Y.

PROCESS FOR MAKING ELECTRODES.—By transforming pulverized materials into a plastic mass capable of being cast to a desired shape and size. Patent 1509790. J. M. Stephensen, R. 410, 95 River St., Hoboken, N. J.

ELECTRIC BATTERY WITH AN ABSORBED LIQUID.—Characterized by a negative electrode having multiple parallel plane elements forming a series of compartments covered with a spongy insulating coating. Patent 1510364. G. Weissmann, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

ELECTRIC HEATER.—Through which air may freely circulate for not only heating a room, but for maintaining the plug cool. Patent 1510796. C. E. Patterson, Box 430, Arcade Hardware Dept., Los Angeles, Calif.

DETACHABLE COUPLING FOR ELECTRIC WIRES.—By which terminals may be quickly connected, heating of the terminals while current is passing, being eliminated. Patent 1510977. W. T. Clark, 948 Greenfield Ave., Milwaukee, Wis.

RADIO COUPLER CONSTRUCTION.—In which one or more switches can be adjusted and operated by the manipulation of a single knob. Patent 1511127. C. Hermann, 102 East End Ave., New York, N. Y.

CIRCUIT CONTROLLER—Of the character incorporated in the circuits of block signaling or similar systems. Patent 1511502. F. A. Cantwell, Box 1, Irving, Kan.

Of Interest to Farmers

BALANCE SWITCH FOR TRACTORS.—Adapted for farm tractors, the switch closing to kill a motor when the tractor is tilted at a dangerous angle. Patent 1510318. E. G. Green, c/o J. W. Brandt, Wolcott, N. Y.

PITMAN CONNECTION FOR MOWING MACHINES.—Wherein the cutter bar may be spread apart in order to permit of ready detachment for replacement or repair. Patent 1510817. F. Baker, Hinton, W. Va.

MANURE SPREADER AND FEED MECHANISM THEREFOR—Having a feed mechanism of the ratchet type, which is of simple and durable construction. Patent 1512448. N. H. Bloom, c/o Bloom Mfg. Co., Nashua, Iowa.

Of General Interest

VANITY CASE—Whereby upon swinging the cover to open position, the various compacts become simultaneously accessible. Patent 1508339. M. Kline, 3 W. 29th St., New York, N. Y.

SAFETY RAZOR—Having a single blade of the hollow-ground variety, adapted for alternate attachment to its handle for shaving or honing. Patent 1507737. H. James, Montrose, Ill.

ATTACHMENT FOR OPTICAL INSTRUMENTS—In the form of an auxiliary lens for microscopes, telescopes, field-glasses, engineer's transit or the like. Patent 1508043. F. L. Barrows, Moclips, Wash.

WASHING APPLIANCE — Providing an efficient rubbing tool which assists in directing the water flow and preventing splashing. Patent 1508265. H. Bailey, 2307 Morris Ave., New York, N. Y.

ELASTIC WEBBING—Of metal instead of rubber, with a covering to protect the same. Patent 1508321. J. C. Heintz, 15 Asgood St., Stapleton, S. I., N. Y.

FOLDING COMB AND MIRROR—Wherein the parts are arranged to be adjusted and separated to perform their various functions. Patent 1508306. D. Strulson, 35 6th Ave., New York, N. Y.

CONDUIT—For use as a drain or culvert pipe, compact to transport, easy to assemble, strong in use. Patent 1508347. J. O. Montreuil, Dept. of Roads, Parliament Bldg., Quebec, Canada.

CARBOY—With guide-ways and resilient lateral supporting members for the bottle. Patent 1508343. C. Lefkowitz, c/o National Box & Lumber Co., 350 South St., Newark, N. J.

FABRIC—Of the chiffon type, having special stiffening members at spaced intervals, preventing a stiffer construction when finished. Patent 1508344. O. Lion, c/o Lion & Co., 118 E. 25th St., New York, N. Y.

AWNING ATTACHMENT—For the ready and secure connection of a hoist rope to an awning weight, for raising or lowering the same. Patent 1508333. F. Huth, 110th Ave., Queens Village, L. I., N. Y.

FOUNTAIN PEN—With means for preventing the overflow of ink when the pen is filled. Patent 1507729. A. O. Dahlberg, 145 Iota Court, Madison, Wis.

APPLIANCE FOR PERMANENT HAIR WAVING.—With means for winding the hair on a so-called curler and maintaining any desired tension. Patent 1510448. A. H. Bongers, 7 The Exchange, Muswell Hill, London, N. 10, England.

DATING-STAMP LOCK.—For locking the legend carrying members in different adjusted positions without interfering with the usual operation thereof. Patent 1510327. A. Miller, 70 Greenwood Ave., East Orange, N. J.

CONCRETE ROAD FORM—Intended for repeated use and ready removal from one job to another. Patent 1507750. C. M. Molstad, 14 Preston Court, Lexington, Ky.

SHIELD—Particularly adapted for painters to prevent the unintentional application of paint to surfaces, adjacent moldings or other objects. Patent 1507774. A. B. Hill, 7251 Oglesby Ave., Chicago, Ill.

DOOR OPENING DEVICE—For use in connection with the operation of gates, or doors, to be opened without alighting from a vehicle. Patent 1508270. C. A. Connelly, Shelby, Ohio.

CARD HOLDER.—Especially adapted for use in holding labels and the like, on a package during shipment through the mails. Patent 1508692. C. T. Goewey, South Bend, Ind.

FEED BAG.—With a central compartment for the animal's head, and magazines on either side for the automatic supply of food. Patent 1508964. G. Doutney, 567 Halsey St., Brooklyn, N. Y.

RECEPTACLE FOR FLAG.—Adapted to be attached to a flag pole to receive the flag when not in use. Patent 1508980. A. V. Kelly, 780 St. Johns Place, Brooklyn, N. Y.

MOORING LINE.—Attachment for relieving the strain occasioned by the movement of a vessel relative to its mooring. Patent 1509,012. R. R. Whiting, c/o T. L. Crocker, 247 Park Ave., New York, N. Y.

MAGNIFYING GLASS FOR TELEPHONES.—For attachment to the ordinary type of telephone that the person may more easily read the context of a directory. Patent 1508434. J. J. Ayres, c/o T. R. J. Ayres & Sons, 509 Main St., Keokuk, Iowa.

COMBINATION CANE.—Which includes an electric flash light, and a concealed knife which may be quickly brought into use. Patent 1509157. P. Leano, c/o Bureau of Public Works, Manila, Philippine Islands.

SKYLIGHT.—Having a pivotally mounted sash and means for establishing a watertight joint between the sash and the frame. Patent 1509757. S. Heyman, 965 Putnam Ave., Brooklyn, N. Y.

DRESS FORM.—Simulating a part of the human body, and serving to retain a garment in place thereon. Patent 1509769. E. T. Palmenberg, c/o Palmenberg & Sons, 63 W. 36th St., New York, N. Y.

CLEANING DEVICE.—Adapted for cleaning the interior of bath tubs or flat surfaces such as walls and ceilings. Patent 1509381. G. G. Townsend, Frostburg, Md.

PROJECTILE.—Which may be maintained in the air for a longer time than is usual, and equipped with a rudder for maintaining a straight line. Patent 1509178. H. M. Ratcliff, Blythville, Ark.

RAZOR STROP.—With means for regulating the moisture content of the strop or strops irrespective of the atmosphere. Patent 1509347. G. E. Faupel, c/o Dougherty & Dougherty, First National Bank Bldg., Beeville, Texas.

RETURNABLE LABEL.—For packages which are to be sent back and forth a number of times between parties. Patent 1509776. H. E. Plimpton, 75 Bond St., Norwood, Mass.

COMBINED LEASH AND WHIP.—In which the loop forming the hand-grip may be used as a whip or to secure the animal to a projection. Patent 1509781. A. Roth, c/o Roth Orthopedic Inst., 125 W. 97th St., New York, N. Y.

WATCH HOLDER.—For attaching in a pocket to receive a watch, or similar article, and to retain the same. Patent 1509766. P. H. Nolting, c/o American Tippe, 300 Communipaw Ave., Jersey City, N. J.

DRINKING CUP.—From which a child can drink, yet cannot contaminate the contents of the cup in playing. Patent 1509734. W. P. Langley, 276 E. New Lenox Road, Pittsfield, Mass.

FILM AND PLATE HOLDER.—In which a plurality of cut films or plates may be securely held while being subjected to the development process. Patent 1509701. H. D. Bernstein, 43 W. 24th St., New York, N. Y.

CIGARETTE CASE.—Simulating an automatic pistol, the cover being opened by the action of the trigger. Patent 1510331. K. Newmark, 154 Nassau St., New York, N. Y.

PORT LIGHT.—For marine vessels, with means for conveniently opening or closing the light or its shutter. Patent 1510330. D. Nechroni, 1949 Gildersleeve Ave., Classon Point, Bronx, N. Y.

INKING PAD AND STAMP RACK.—In which the pad cover forms a rack for the rubber stamps. Patent 1510312. E. F. Cunningham, 330 Berry St., Brooklyn, N. Y.

ADJUSTABLE CRUTCH.—Whereby adjustment can be made by the user to meet every convenience, and retained against accidental derangement. Patent 1508686. E. P. Gayetty, Fortuna, Calif.

KNOCKDOWN PLAYHOUSE STRUCTURE.—Composed of minimum number of parts, easily assembled to form a log cabin playhouse for children. Patent 1510326. J. A. Locke, Marion, Mont.

SPRING-WINDING ATTACHMENT FOR TALKING MACHINE.—Whereby the winding of the spring is automatically started after the playing of each record. Patent 1510309. A. H. Collier and A. R. Winkler, 22 E. 42nd St., Bayonne, N. J.

WALL FORM.—Adapted to build concrete walls, resembling a series of logs for a cabin or tiles for a house. Patent 1510082. J. Aarsrud, 1538 N. Fairfield Ave., Chicago, Ill.

ERASER SUPPORT.—For supporting the eraser in the palm of the hand, when not in use. Patent 1509952. M. M. Hunting, 1507 E. 65th St., Chicago, Ill.

Hardware and Tools

METHOD FOR FORMING DRILL BITS—By providing in one set of dies a plurality of apertures into which the stock can be successively inserted until assuming its finished form. Patent 1508268. J. J. Brossoit, 1024 Winsor St., Salt Lake City, Utah.

COMBINATION LOCK.—Opening only from the outside of a door by a person knowing the combination, but by anyone from the inside. Patent 1508948. G. A. Anderson, 4004 Rombouts Ave., New York, N. Y.

DISPENSING FAUCET.—Which will close automatically if the valve mechanism is removed for repair or other purposes. Patent 1508291. W. S. Penfield, 141 Beaver St., San Francisco, Cal.

CARPENTER'S SQUARE.—Which in addition to being a square, facilitates the correct marking of doors or windows for the application of hardware. Patent 1509703. J. S. Bourgeois, c/o Hotel Ferrari, 2-4 Cambridge St., Boston, Mass.

WIRE-FENCE TIE.—For supporting wire fences and associating the fence with a fence post. Patent 1511099. P. T. Bailey, Box 272, R. R. 2, Newport, R. I.

WASHING TOOL.—Having means for directing strong jets of water through the perforated liner of a deep well for cleansing the same. Patent 1510581. A. Boynton, 1019 City National Bank Bldg., San Antonio, Texas.

OIL BURNER.—Which may be operated in connection with a source of air or steam supply of moderate pressure. Patent 1510639. E. C. Wills, 330 Grove St., Newark, N. J.

WRENCH — Readily convertible from a socket wrench to an angle wrench without impairing its power. Patent 1511395. K. Canan, 1940 Spearing St., Jacksonville, Fla.

BLADE HONING AND SHARPENING DEVICE—For facilitating the honing and sharpening of safety razor blades. Patent 1511958. F. P. Gallipoli, 1022 Old Kingsbridge Road, New York, N. Y.

TEMPER SCREW — With ratchet handle, which may be adjusted for either right or left hand turners. Patent 1512650. J.

Strobel, c/o Keystone Machinery Co., Tulsa, Okla.

HAIR CLIPPER — Provided with cutting plates, power driven, to cut in either direction without reversing its position. Patent 1512777. J. Love, 361 Frank Ave., Huron, S. D.

METAL RAIL FOR WINDOWS, DOORS AND THE LIKE—Which has means for locking a panel in place, without using a molding or putty. Patent 1512112. W. P. Lawrence, 1030 Grant St., Denver, Colo.

Heating and Lighting

RADIATOR.—Using all the heat units before they are carried to the chimney, but keeping the gas fumes from the room. Patent 1508276. A. W. Edwards, 1529½-7th St., Sacramento, Cal.

TORCH.—Of the self-blowing type in which the gas or burner tube may be readily cleaned. Patent 1509077. E. Folgman, c/o Jeffers, 1073 Bedford Ave., Brooklyn, N. Y.

COMBINATION COOKER AND STEAMER.—In which foodstuffs may be cooked and maintained warm and free from an accumulation of moisture. Patent 1509752. A. Hassler and H. Rothman, c/o Harry Rothman, 59 Stanton St., New York, N. Y.

OIL BURNER—For furnishing heat in connection with steam boilers, the oil being atomized by live steam. Patent 1511519. M. Raber, 116 Lava Road, Bend, Oregon.

STOVE—With a plurality of gas burners and pockets, and tubes whereby the heat may pass from one pocket to another. Patent 1511941. I. W. Bromon, Wilkinsburg, Penn.

Machines and Mechanical Devices

DISPENSING DEVICE.—With mechanism which will insure the dispensing of an article, although but a few remain to be dispensed. Patent 1508952. C. H. Bennett, 5 Cherry St., Mount Morris, N. Y.

CHARGING DEVICE FOR GREASE GUNS.—By which grease may be forced into the gun in a convenient manner the customary hand filling operation being avoided. Patent 1508,341. J. E. Lathan, 1454 Pine St., San Francisco, Calif.

PISTON STRUCTURE.—Having a self-expanding packing sleeve designed to constantly establish a tight joint between the piston and cylinder. Patent 1508264. A. L. Armentrout, 123½ North Newlin St., Whittier, Calif.

BAILER BOTTOM.—Wherein the downward thrust is utilized as a means to open the bailer for the reception of the mud. Patent 1508771. A. Boynton, 1019 City National Bank Bldg., San Antonio, Texas.

VALVE.—Having mechanism adapted to permit the flow of liquid from a tank until only a given quantity remains. Patent 1508754. P. D. Sprenger and C. W. McPherron, c/o Eldridge Buick Co., 802 E. Pike St., Seattle, Wash.

VENDING MACHINE.—Particularly designed for vending perishable confections, such as ice-creams, and for keeping the articles in a salable state. Patent 1509249. L. C. and J. C. Miles, 1503 No. 25th St., Boise, Idaho.

VALVE LATHE.—Having automatic means for moving the cutter to a 45 degree angle to the valve during the cutting operation. Patent 1509378. W. C. Schroeck and W. Lissmann, c/o William Lissmann, 1136 W. Winchester Ave., Chicago, Ill.

DIGGING BUCKET.—So constructed that the bucket may be removed from the well without removing the driving rods. Patent 1509811. W. J. Patzke, c/o Miss Emma A. Patzke, Miller, S. D.

ROAD MACHINERY.—Which may be easily controlled and will be effective to release, distribute and pack the road material. Patent 1509797. W. L. Towner, c/o L. B. Towner & Son, 3rd and Lake St., Muskogee, Okla.

MACHINE FOR ATTACHING BEADS TO FABRICS.—In the form of a simple attachment for mounting on sewing machines. Patent 1510378. R. Bolandi, 202 W. 105th St., New York, N. Y.

POLISHING OR BUFFING DEVICE.—Of the rotary type, which is light and adapted to be easily manipulated for changing brushes. Patent 1510116. A. L. Van Meter, 1320 Lowerline St., New Orleans, La.

ICE-MAKING APPARATUS.—Whereby impurities may be thoroughly expelled from the water during the freezing period. Patent 1510324. R. G. Kaping, Libertyville, Ill.

PULLING DEVICE.—Adapted for pulling machinery, or hoisting purposes, or as a load binder for securing articles on a vehicle. Patent 1510035. F. J. Bradley, 801 Leonard St., Fostoria, Ohio.

DRIVE MEANS FOR PHONOGRAPHS.—So constructed that by raising the cover of the cabinet, the record table will be caused to turn. Patent 1510381. A. A. Breder, c/o Katherine B. Miller, Box 5, Egg Harbor City, N. J.

GRIPPING MECHANISM FOR PRINTING PRESSES.—Which greatly increases the speed of operation of removing a sheet from the platen, and depositing the same. Patent 1510310. H. C. Cowdrey, 312 W. 43rd St., New York, N. Y.

OILING DEVICE FOR THREADING MACHINES. — Which automatically operates, upon revolution, to supply oil to a point adjacent the cutting elements. Patent 1511,144. A. F. Thorsten, 349 11th St., Brooklyn, N. Y.

VENDING MACHINE—With means for detecting coins or slugs made of magnetic material and causing them to be deflected. Patent 1511136. J. Nemo, c/o A. Nemo, 3021 Tilden Ave., Brooklyn, N. Y.

STERILIZER — For destroying pink boll worms, by live steam applied directly to the cotton seeds, without damage thereto. Patent 1510610. P. H. Rylander, c/o Rylander Co., Austin, Texas.

AMALGAMATOR—In the form of a trough, consisting of a plurality of sections readily increased or decreased as required. Patent 1510733. J. C. Wood, Monero, New Mexico.

BUTTON—For use in connection with button-sewing machines, to insure proper alinement of the needle with the stitch receiving openings. Patent 1511101. W. Belsky, c/o Victor F. Nekarda, 230 5th Ave., New York, N. Y.

AUTOMATIC EGG GRADER—Whereby eggs may be quickly graded according to their weight. Patent 1510218. E. Goodwin, Folsom, Calif.

REVERSING MECHANISM AND SAFETY STOPPING DEVICE FOR DYEING MACHINERY—Which prevents the manual turning means being thrown into gear when the machine is being power driven. Patent 1511988. R. N. Towers, c/o Rome Machinery & Foundry Co., Rome, Ga.

SHOE-SHINING MACHINE—With means for distributing the polishing fluid, and subsequently polishing the shoe. Patent 1511241. A. A. Stavick, Box 77, Sioux City, Iowa.

ATTACHMENT FOR SLUG-CASTING TYPE-SETTING MACHINES — Which will facilitate the production of ruled blank forms and vertically ruled tabular composition. Patent 1511571. J. H. McCulley, Box 494, Dillon, Montana.

COCONUT-SHREDDING MACHINE — Which holds the coconut against movement while it is being shredded. Patent 1511947. H. G. Coder, 203 Summit Ave., Jersey City, N. J.

LOCK MECHANISM—Adapted for use on doors in buildings, and may be easily applied. Patent 1511956. E. Flagg, 111 E. 40th St., New York, N. Y.

EVAPORATING APPARATUS — The temperature of which can be controlled, and can never reach a degree dangerous to the products. Patent 1511961. F. N. Halary, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

TREATMENT OF TIN-PLATE SCRAP—For removing and recovering the tin, without employing an electric current from an extraneous source. Patent 1511967. R. A. Holland, 40 Louisa St., Coburg, Victoria, Australia.

FLUSHING VALVE—Employing a cylinder and piston valve and having means to unseat the valve and control the flow of water. Patent 1511927. W. S. White, 4021 Walnut St., Denver, Colo.

SAFETY DEVICE FOR BOILERS—Which will operate when the water in the water compartment falls below a predetermined point. Patent 1511978. J. J. Muhlebach, 2 Muhlebach Court, Far Rockaway, N. Y.

BIN SCALES—With means controlling the outlet of material, so that only a desired quantity will be measured at each operation. Patent 1511950. A. Debay, c/o Mrs. Josie Hubert, Tarentum, Pa.

EMBROIDERING-MACHINE ATTACHMENT — Which shifts and mechanically regulates the embroidering machine stitches and eliminates inaccuracy. Patent 1512738. M. Aronson and W. Baumgart, 1335 Intervale Ave., Bronx, N. Y.

Medical Device

DENTAL APPLIANCE. — Which includes means for illuminating the interior of the mouth for the examination of cavities. Patent 1509041. H. T. Hyams, De Kalb, Texas.

METHOD OF MAKING SETS OF ARTIFICIAL TEETH—And plate from one piece of plastic material to fit the mouth cavity without a permanently attached sheet of metal. Patent 1511161. J. M. Buchanan, 27 So. Main St., Freeport, N. Y.

DENTAL IMPRESSION TRAY — Adjustable for fitting the lower jaw for taking an impression, in making artificial teeth. Patent 1512686. G. A. Harper, 1505 Slattery Bldg., Shreveport, La.

Prime Movers and Their Accessories

VAPORIZER.—For the interposition of fuel supply pipe between the carbureter and engine of an internal combustion engine. Patent 1509742. A. H. Webber, 349 Columbus Ave., Boston, Mass.

DEVICE FOR CONTROLLING THE HEAT OF INTERNAL-COMBUSTION MOTORS.—Adapted to prevent air from passing over the motor when the car is moving. Patent 1509944. J. O. Forgette and R. Legois, c/o Adjustable Blade Fan Mfg. Co., Nadeau, Mich.

MEANS FOR CONTROLLING FLUIDS UNDER PRESSURE.—By which the flow of lubricant for an internal combustion motor may be automatically controlled. Patent 1509939. J. G. Elkin, c/o W. D. Sprague, 184 Hudson St., New York, N. Y.

SPARK-PLUG CLEANING DEVICE — Constructed to clean several sizes of plugs, and small enough to be stored in the tool box of an automobile. Patent 1511106. M. A. Capobianco, 119 Glen Cove Ave., Glen Cove, L. I., N. Y.

RADIATOR FOR INTERNAL-COMBUSTION ENGINE—In which the heat radiating tubes may be easily replaced. Patent 1510828. W. C. Chapin and J. H. Pettee, 41 Fulton St., Rockland, Me.

CARBURETER FOR INTERNAL-COMBUSTION ENGINES—In which liquid fuel may be drawn from the reservoir by the suction of the engine. Patent 1511134. P. Morellini, V. Duprat and H. Eisenschmidt, c/o O. Picard, 97 Rue St. Lazare, Paris, France.

INTERNAL-COMBUSTION ENGINE—In which it is possible to eliminate such parts as crank shafts, wrist pins, connecting rods, cam shafts, poppet valves, etc. Patent 1511985. C. A. Spencer, 7602 De Longpre, Hollywood, Calif.

MUFFLER—Wherein is provided a cut-out for automatically relieving the muffler of excessive pressure, and the engine of excessive back pressure. Patent 1512210. P. H. Gaskins, 1207 Graham Bldg., Jacksonville, Fla.

Railways and Their Accessories

RAIL FASTENER—Designed for use with mine railways of the type employing steel rails. Patent 1505245. J. S. Christmas, 1625 Quarrier St., Charleston, W. Va.

BOGIE FOR ROLLING STOCK.—Provided with lateral members which are constituted by the springs of suspension of the bogie upon its axles. Patent 1508954. F. L. Broussouse, c/o Office Picard, 97 Rue St. Lazare, Paris, France.

WINDOW.—Which will permit the driver of a locomotive, street car, or vehicle to obtain a clear vision. Patent 1509052. H. N. McGaughey, Nettleton, Miss.

Pertaining to Vehicles

CRANK-CASE CONSTRUCTION.—In which the drain is not centrally disposed with respect to the bottom wall, and having novel means for closing the opening. Patent 1509,023. V. W. Page, c/o Victor Page Motor Co., Melrose Ave., Stamford, Conn.

REAR-END SIGNAL FOR VEHICLES.—Arranged to at all times attract the attention of the driver of a following car. Patent 1509049. C. F. Marston, 1704 Church St., Brooklyn, N. Y.

COMBINED BUMPER AND WINCH FOR MOTOR CARS.—The winch being constructed to pull a machine out of roadway obstructions or as an emergency power apparatus. Patent 1508750. W. C. Nabors, c/o Nabors Garage, Mansfield, La.

AUTOMOBILE SIGNAL.—Which may be used by night or day, easily operated and not likely to get out of order. Patent 1510032. C. F. Bliss, Montebello, Calif.

AUTOMOBILE INDICATOR.—Whereby the direction of movement can clearly be indicated from both front and rear of the vehicle. Patent 1509767. C. A. O'Toole, 680 McDonough St., Brooklyn, N. Y.

VEHICLE SPRING.—Which provides for a plurality of co-acting springs coming into play with the normal springs to take up heavy shocks. Patent 1508755. W. E. and E. L. Stanford, Taylorsville, Plumas County, Calif.

CAP FOR RADIATORS AND THE LIKE.—Adapted primarily for use in connection with the filling neck of an automobile radiator. Patent 1509465. J. L. Baya, 419 Atlanta Trust Co. Bldg., Atlanta, Ga.

COVER FOR VEHICLE SPRINGS.—For excluding water dust and grit, and preserving the lubricant. Patent 1510447. D. B. D. Blake, 1439 No. 13th St., St. Louis, Mo.

CONTROL FOR FOUR-WHEEL-BRAKE MECHANISM.—So adjusted that one set of brakes may be operated to the exclusion of the other set. Patent 1510315. H. A. Fuller, 558 Putnam Ave., Brooklyn, N. Y.

INVALID'S VEHICLE.—In the nature of a bicycle capable of manual propulsion, steering or braking by a common manipulating mechanism. Patent 1510311. P. M. Cru, 341 E. 68th St., New York, N. Y.

AUTOMOBILE SIGNAL—Involving a pointer indicating direction and a stop signal, operated by electromagnetic means. Patent 1511100. W. L. Baldwin, c/o Am. Tel. & Tel. Co., 925 3rd Ave., Troy, N. Y.

SELECTIVE CONTROLLING MECHANISM—In the form of a foot pedal with variable speed gearsets for Ford cars, which is automatically operable. Patent 1511132. C. F. Marston, 1704 Church Ave., Brooklyn, N. Y.

AUTOMOBILE LOCK—Which in combination with a chain, is adapted for locking spare tires or other parts. Patent 1511119. J. P. Geraghty, 493 Grove St., Jersey City, N. J.

PRESSURE GAGE—For indicating to the driver the number of pounds of oil pressure in the forced feed lubricating system. Patent 1510193. B. P. Pryor, Jr., Maxwell, Calif.

SIGNALING DEVICE—Adapted for use in connection with automobiles as a safety device for indicating the direction of movement. Patent 1511792. M. H. Weldy, 1035½ So. Bexel St., Los Angeles, Calif.

ANTITHEFT DEVICE—Which provides a locking means for the steering rod, and an alarm system for motor vehicles. Patent 1510823. B. F. Betts, Tonopah, Nevada.

MOTOR CYCLE FRAME—In which all heat-made joints, such as those made by welding and brazing, are eliminated. Patent 1511,631. V. W. Page, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn.

AIR PUMP—Adapted for use as a tire pump or for similar purposes. Patent 1511,971. J. W. Hunter, Sydenham, Ontario, Canada.

AUTOMOBILE WHEEL-ALINING DEVICE—Which will automatically return steering wheels to straight-ahead position upon the release of tension. Patent 1511942. W. E. Burgin, Box 146, Crab Orchard, Ky.

OPERATING MEANS FOR REAR-END VEHICLE SIGNALS—Arranged to enable the operator to display a danger signal, or a turning signal, when applying the brakes. Patent 1512854. C. F. Marston, c/o Automatic Signal Co., 2202 Tilden Ave., Flatbush, Brooklyn, N. Y.

VEHICLE VENTILATOR — For closed vehicles, serving to ventilate the interior, but prevent the entry of rain or snow. Patent 1512754. J. Gabor, 2972 W. 28th St., Coney Island, N. Y.

DEMOUNTABLE WHEEL RIM—The sections of which may be readily assembled and secured on a wheel, and disassembled when changing a tire. Patent 1512811. F. J. Spittler, Times Bldg., 42d St. and Broadway, New York, N. Y.

LUBRICATING SYSTEM—Which will automatically supply to the vehicle parts the proper amount of lubricant, at a time when most needed. Patent 1512216. P. H. Gaskins, 1207 Graham Bldg., Jacksonville, Fla.

TURNTABLE—Which automatically turns a car 180 degrees so that it may be driven in and out of a garage in forward speed. Patent 1512640. F. J. Rump, Versailles, Kentucky.

TRAVELING KIT—Carried on the running board or rear of a car, and opened as a table, or bed, with tent covering. Patent 1512725. J. M. Thomas, 1206 Tampa St., Tampa, Fla.

Which Radio Set to Buy

This Department Inaugurates a New Service to Our Readers

AMONG the questions that readers ask us about radio three are in the great majority:

"Is the radio craze going to last?"

"Can I get a radio set simple and dependable enough to be used and operated by someone who is not especially expert?"

"What is the best radio set to buy?"

The answer to the first two questions is an emphatic "yes." Radio is here to stay. Manufacturers and business men who guessed the contrary two or three years ago are already lamenting bad judgment and missed opportunities. Also, it is possible to obtain scores of sets that are simple to operate.

The third question is not so easy to answer. This new department is our attempt to do so.

The plain truth about it is that there is no "best" radio set, any more than there is a "best" suit of clothes or a "best" wife. It all depends on who wants it. One man will want only to hear the broadcasting from local stations and he will not mind wearing the two telephones and the band over his head. The next man will demand to bring in every broadcasting station in the country on a loudspeaker every night in the year.

The first man's demands are modest. He can get what he wants with almost any of the low-priced receivers. The second man is not going to get what he wants at all. No radio receiver yet devised will bring in every distant station on any night when you want to hear them. Anyone—dealer, manufacturer or fan—who tells you that he can do this is letting his enthusiasm run away with him.

To decide about buying a radio receiver you have to decide, first of all, just what you want. Are you anxious for distance or content with local stations? Do you demand a loudspeaker or not? Can you erect an outdoor antenna over a hundred feet long or must you be satisfied with a short one or with an indoor loop? How much money will you spend?

In the following table we have listed most of the factory-made, ready-for-use radio receivers now on the market in the United States. We give the essential information about each. Decide about your requirements, go through this list, pick out in that way the one that you want. Better still, pick out from the table the three or four receivers that you like best, then go to a dealer and look them over.

Important!

If you buy a receiver, using this table as your guide, and find the results unsatisfactory please write and tell us exactly what proved to be wrong. Address The Editor, Scientific American, 233 Broadway, New York, N. Y.

All the receivers listed below are well known to the staff of the Scientific American. They are worth what you pay for them and will give you good service, each within its limitations. The price you must pay for a complete outfit will be, of course, the price of the receiver itself (as listed), plus the cost of the equipment listed under accessories.

It is impossible to state the exact cost of these accessories. This depends on you. There is a wide latitude in price. Loudspeakers, for example, can be had from eight or ten dollars up to a hundred.

As to batteries, the dry-battery outfits cost less in the beginning, but for sets having three tubes or more the upkeep is less with storage batteries. Also, the storage battery (used for the filament or "A" battery) will give you greater volume, tube for tube, and more dependable operation. Dry batteries, on the other hand, are more convenient and more portable. As before, it all depends on what *you* want.

An outdoor antenna, properly erected, will give you greater distance than a loop. Or, what is the same thing, you can pay less for your set and get the same results. But a loop set, although more expensive, will usually give you clearer reception and greater ease of separating the broadcast stations from one another—what the radio fan calls "selectivity." Location has much to do with this. Some places are good for radio, others are bad. Any radio amateur can tell you all about this. In general, the country is better for reception than the city.

The distance obtainable with a radio receiver depends on many things. Locality is a main one. Another is the weather. Still another is the skill of the person who does the tuning. The hearing of distant stations with a given type of set *cannot* be guaranteed. Don't believe anyone who tells you that it can.

If some receiver in which you are especially interested is missing from this table that does not mean necessarily that the receiver has failed to pass our inspection. A number of receivers are awaiting test. If they pass our inspection they will be listed next month.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
CROSLEY 50	CROSLEY RADIO CORPORATION	$14.50	One tube, "A" and "B" batteries antenna equipment and phones. Cost from $18.00 to $30.00.	Single circuit regenerative	Outdoor	This is a simple one-tube outfit built to sell at as low a price as possible consistent with good results. Will bring in stations up to 500 miles away with headphones.
CROSLEY 50 P	CROSLEY RADIO CORPORATION	$18.00	One tube, "A" and "B" batteries, phones and length of flexible wire. Cost approx. $17.00.	Same as Crosley 50	Outdoor	This is the Crosley 50 made up in portable form. Should be used with dry battery tubes to keep down the weight.
CROSLEY 51	CROSLEY RADIO CORPORATION	$18.50	Two tubes, "A" and "B" batteries, phones and antenna equipment. Cost $23.00 to $35.00.	Same as Crosley 50 plus one stage amplifier	Outdoor	Same as the Crosley 50 with one stage of audio amplification which gives greater volume of sound.
"SHEPCO" All Purpose	THERMIODYNE RADIO CORP.	$21.00	One tube, "A" and "B" batteries, antenna equipment and phones. Cost $18.00 to $30.00.	Experimental	Outdoor	A receiver for the man who wishes to experiment with various circuits. The leads from the various parts are brought up to a binding post panel so that almost any circuit may be tried by connecting the posts in different ways.
CROSLEY 51 P	CROSLEY RADIO CORPORATION	$25.00	Two tubes, "A" and "B" batteries, phones and wire for antenna. Cost $20.00 to $32.00.	Same as Crosley 51	Outdoor	Same as the Crosley 51 but fitted into a portable case.
MRC-10	MICHIGAN RADIO CORP.	$27.00	One tube, "A" and "B" batteries, phones and antenna equipment. Cost $18.00 to $30.00	Regenerative	Outdoor	Is fitted with levers instead of the usual dials for tuning. Good for headphone reception up to 500 miles or more under favorable conditions. Three controls.
MODEL R	FARAWAY RADIO CO.	$29.50	Two tubes, "A" and "B" batteries, phones and antenna equipment. Cost $23.00 to $35.00.	One stage radio-frequency and detector	Outdoor	Designed to bring in distant stations with headphones. Two tuning controls. Metal panel finished in gold or platinum color.
CROSLEY 52	CROSLEY RADIO CORPORATION	$30.00	Three tubes, "A" and "B" batteries, loudspeaker, phones and antenna equipment. Cost $40.00 to $60.00.	Same as Crosley 50	Outdoor	Essentially the same as Crosley 50 with two stages of audio amplification added to give loudspeaker operation on nearby and semi-distant stations. Two controls for tuning.
MRC-2	MICHIGAN RADIO CORP.	$32.50	Two tubes, "A" and "B" batteries, phones and antenna equipment. Cost $23.00 to $35.00.	Regenerative	Outdoor	Somewhat the same as MRC-10 but has one audio stage added so that it will operate loudspeaker on nearby, powerful stations.
TYPE 224	C. D. TUSKA CO.	$35.00	One tube, "A" and "B" batteries, phones and antenna equipment. Cost $18.00 to $30.00.	Regenerative	Outdoor	A high-grade, single-tube receiver for those who wish to get maximum distance and selectivity with one tube. Tunes sharply with two controls.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
RADIOLA III	RADIO CORP. OF AMERICA	$35.00 Includes two tubes and headphones.	"A," "B" and "C" batteries and antenna equipment. Cost $10.00 to $15.00.	Regenerative	Outdoor	Gives excellent selectivity and is sensitive. Uses dry cell tubes only and will operate a loudspeaker on nearby, powerful stations.
MODEL F	FARAWAY RADIO CO.	$59.50	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	One stage transformer coupled radio-frequency.	Outdoor or indoor	Simple to tune and brings in distant stations on loudspeaker under favorable conditions. Metal panel finished in gold or platinum color.
FRESHMAN MASTERPIECE	CHAS. FRESHMAN CO.	$60.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00	Tuned radio	Outdoor	Brings in local stations on loudspeaker with good tone
RADIOLA III-A	RADIO CORP. OF AMERICA	$65.00 Includes four tubes and headphones.	"A," "B" and "C" batteries, loudspeaker and antenna equipment. Cost $25.00 to $50.00.	Regenerative	Outdoor or indoor	Uses 1½-volt tubes, which can be operated by dry batteries, or 2-volt storage battery. Sensitive and selective. Brings in distant stations on loudspeaker under favorable conditions. Two tuning controls.
TRIRDYN	CROSLEY RADIO CORPORATION	$65.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $80.00.	Radio-frequency plus reflex	Outdoor or indoor	Gives marked selectivity and is sensitive to distant signals. Two tuning controls which may be logged for each station.
TYPE T	WARE RADIO CORPORATION	$65.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $35.00 to $50.00.	Neutrodyne reflex	Outdoor	Attains maximum results with three 199 type tubes. Sensitive and selective with simple tuning by two dials. Will operate loudspeaker on distant stations under favorable conditions.
MODEL 9	ATWATER-KENT MFG. CO.	$65.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor	Sensitive and selective with two controls. Open set with apparatus mounted on a board, no panel. Brings in distant stations when conditions are right.
FADA "Neutro-Junior"	F. A. D. ANDREA, INC.	$75.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $80.00.	Neutrodyne reflex	Outdoor	Sensitive and selective. Tuned by two dials. Loudspeaker volume on distant stations under favorable conditions.
MODEL V	COLIN B. KENNEDY CORP.	$75.00	Three tubes, "A" and "B" batteries, antenna equipment. Cost $55.00 to $80.00.	Regenerative	Outdoor	Designed for home use to receive local and high-powered distant stations on loudspeaker. Uses either dry battery or storage battery tubes.
RADIODYNE WC-5-B	WESTERN COIL & ELECTRICAL CO.	$80.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor	Brings in distant stations on loudspeaker with simple tuning control. Sensitive and selective.
TYPE 301	C. D. TUSKA CO.	$85.00	Three tubes, "A" and "B" batteries, headphones and loudspeaker, antenna equipment. Cost $55.00 to $80.00.	Radio-frequency reflex	Outdoor	Will bring in distant stations and is highly selective. Two main tuning controls.
MODEL 10	ATWATER-KENT MFG. CO.	$85.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Open set with apparatus mounted on a board, no panel. Sensitive and selective, with three controls. Brings in distant stations on loudspeaker under favorable conditions.
MODEL 19	ATWATER-KENT MFG. CO.	$85.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor	Electrically the same as Atwater-Kent Model 9 except that it is fitted in cabinet.
MRC-3	MICHIGAN RADIO CORP.	$87.50	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $80.00.	Regenerative	Outdoor	Three levers instead of the usual dials are used to control this receiver. Sensitive and selective. Will bring in moderately distant stations on a loudspeaker.
DAY-FAN OEM-11	DAYTON FAN & MOTOR CO.	$90.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment.	Radio-frequency reflex	Outdoor or indoor	A combination of radio-frequency and reflex circuits. Gives loudspeaker results. Easy to tune.
MODEL MW	MIDWEST RADIO CO.	$95.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Simple tuning and brings in distant stations on loudspeaker under favorable conditions.
ZENITH 4 R	ZENITH RADIO CORP.	$95.00	Four tubes, "A" and B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Regenerative	Outdoor or indoor	Highly sensitive and selective brings in distant stations on loudspeaker under favorable conditions. Three controls for tuning. Can be used with dry battery or storage battery tubes.
DAY-FAN OEM-7	DAYTON FAN & MOTOR CO.	$98.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Radio-frequency reflex	Outdoor or indoor	Clear tone, selective and sensitive. Tunes easily. Economical in current consumption.
EDISONDYNE	EDISON RADIO CORP.	$100.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Tunes easily with three dials which may be logged for each station. Separate rheostats for each tube except two audio tubes which are on same rheostat.
ELECTROLA	AMERICAN SPECIALTY CO.	$100.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Very low "B" battery current consumption. Cushion sockets to eliminate microphonic noises. Sensitive and selective.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
MODEL 20	ATWATER-KENT MFG. CO.	$100.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	This receiver is the same as Model 10 except that it is mounted in a cabinet.
MODEL N R-12	FREED-EISEMANN RADIO CORP.	$100.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Neutrodyne	Outdoor	Selective and sensitive. Will give loud signals on local stations and brings in distant stations when conditions are right.
MODEL III	COLIN B. KENNEDY CORP.	$101.50 Includes headphones	Three tubes, "A" and "B" batteries, flexible wire for antenna. Cost approx. $25.00.	Regenerative	Outdoor	This is the Model V Kennedy receiver constructed for portability in an imitation leather case with cover containing a compartment for headphones and coiled antenna wire.
MODEL VI	COLIN B. KENNEDY CORP.	$105.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Regenerative	Outdoor or indoor	Selective and sensitive, gives great volume on loudspeaker on local and semi-distant stations.
MODEL 12	ATWATER-KENT MFG. CO.	$105.00	Six tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	This receiver has the same characteristics as Model 10 with an extra tube added to give great volume on local and distant signals. Three controls, sensitive and selective.
MA 18	MU-RAD LABORATORIES, INC.	$110.00	Five tubes, "A" and "B" batteries, loudspeaker, antenna equipment. Cost $65.00 to $85.00.	Transformer coupled radio-frequency	Outdoor or indoor	Selective and sensitive, low current consumption both "A" and "B" batteries. Gives loudspeaker results on local and distant stations under favorable conditions. One tuning control.
TYPE XL-5	A. C. ELECTRICAL MFG. CO.	$115.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive. Three controls. Brings in distant stations on loudspeaker under favorable conditions.
TYPE NO. 110	FEDERAL TEL. MFG. CORP.	$117.00 Includes headphones and three tubes	"A" and "B" batteries, antenna equipment and loudspeaker. Cost $20.00 to $50.00.	Transformer coupled radio-frequency	Outdoor	One major control for wavelengths. Selectivity can be varied to suit local conditions. Sensitive on distant signals.
FADA "One-Sixty"	F. A. D. ANDREA & CO.	$120.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Neutrodyne reflex	Outdoor or indoor	Three controls for tuning. Sensitive and selective, brings in distant stations on loudspeaker under favorable conditions.
T R F MAGNAVOX	MAGNAVOX CO.	$125.00 Includes a Magnavox reproducer	Five tubes, "A" and "B" batteries, antenna equipment. Cost $40.00 to $60.00.	Tuned radio-frequency	Outdoor or indoor	Simple to operate as the special type of variometers used for tuning are geared to one control on the panel. Highly selective and sensitive.
BRANDOLA	J. F. BRANDEIS CORP.	$125.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	One dial control for tuning and resistance coupled amplification at audio-frequencies result in simple operation and quality of reproduction.
TYPE CS-32	WM. J. MURDOCK CO.	$125.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective, will bring in distant stations on loudspeaker under favorable conditions.
TYPE 6-D	EISEMANN MAGNETO CORP.	$125.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Three tuning controls. Sensitive and selective. Brings in distant stations on loudspeaker when conditions are favorable.
MODEL 7	PFANSTIEHL RADIO CO.	$140.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Station finder engraved on the panel materially aids in tuning stations. Gives loudspeaker volume or local and semi-distant stations.
GN 2	GILFILLAN BROS., INC.	$140.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Three tuning controls according to the standard neutrodyne arrangement. Double range voltmeter on panel. Sensitive.
M.S. 24 Melco Supreme	AMSCO PRODUCTS, INC.	$140.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive, inductively tuned with three controls. Compensating condensers controlled by dials so that various types of tubes may be used. Brings in distant stations on loudspeaker.
THERMIODYNE T F 6	THERMIODYNE RADIO CORP.	$140.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective, single control for tuning. Brings in distant stations on loudspeaker under favorable conditions.
MODEL XV	COLIN B. KENNEDY CORP.	$142.50	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Two tuning controls, brings in distant stations when conditions are favorable. Selective and sensitive.
MODEL N R-5	FREED-EISEMANN RADIO CORP.	$150.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Same as NR-12, listed under $100.00, above, but gives greater volume on distant stations.
RADIOLA REGENOFLEX	RADIO CORP. OF AMERICA	$150.00	Four tubes, "A," "B" and "C" batteries, antenna equipment and loudspeaker. Cost $45.00 to $65.00.	Regenerative	Outdoor or indoor	Sensitive and selective. Arranged to operate on dry battery tubes. Gives excellent volume on loudspeaker from local and distant stations when conditions are favorable.
MRC-4	MICHIGAN RADIO CORP.	$150.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Levers are used for tuning instead of dials. Sensitive and selective. Cushion sockets to cut out microphonic noises.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
Radiodyne W C 10	Western Coil & Electrical Co.	$150.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective, easy to tune. Brings in distant stations on loudspeaker when conditions are favorable.
Type X	Ware Radio Corp.	$150.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $45.00 to $65.00.	Neutrodyne reflex	Outdoor or indoor	Gives best results possible with four dry battery tubes. Not adapted to storage battery tubes. Sensitive and selective. Operates loudspeaker on local and semi-distant stations.
Superdyne	C. D. Tuska Co.	$150.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Superdyne	Outdoor or indoor	Extremely selective and sensitive. Two tuning controls. Brings in distant stations.
M.S. 25 Melco Supreme	Amsco Products, Inc.	$150.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Highly selective and sensitive. Inductively tuned with three controls. Compensating condensers mounted on panel with dials so that receiver can be instantly adjusted for different types of tubes.
Synchrophase Type MU-1	A. H. Grebe & Co., Inc.	$155.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	An entirely new system of condenser mounting and dial arrangement makes tuning easy. Highly selective and sensitive. Gives loudspeaker results on distant stations.
Type No. 102	Federal Tel. Mfg. Corp.	$156.00 Includes headphones and four tubes	"A" and "B" batteries, antenna equipment and loudspeaker. Cost $20.00 to $50.00.	Transformer coupled radio-frequency	Outdoor or indoor	Designed primarily for operation with dry battery tubes, but storage battery tubes may also be used with good results. Two main tuning controls give selectivity and sensitivity.
Zenith 3R	Zenith Radio Corp.	$160.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Regenerative	Outdoor or indoor	Highly selective and sensitive. Three controls. Brings in distant stations on loudspeaker when conditions are favorable. Good quality of reproduction. Dry or storage batteries can be used.
Neutroceiver	F. A. D. Andrea, Inc.	$160.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Selective and sensitive. Three dials control the tuning. Brings in distant stations on loudspeaker under favorable conditions and give plenty of volume on local stations.
Inverse Duplex Type 2-S-4	Mercury Radio Products Co.	$165.00 With loop	Four tubes, "A" and "B" batteries, loudspeaker. Cost $55.00 to $75.00.	Inverse reflex	Loop or antenna	Three vernier condensers used for tuning. Selective and sensitive. Gives loudspeaker results on distant stations under favorable conditions.
D-12	DeForest Radio Co.	$165.00 Complete with loop	None	Tuned radio-frequency reflexed	Loop	This receiver uses four tubes and is sensitive and selective. Brings in distant stations with good volume when conditions are favorable.
Type W	Ware Radio Corp.	$175.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Three controls. Brings in distant stations on loudspeaker when conditions are favorable.
Type B	Eagle Radio Co.	$175.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Three controls with large knobbed dials make it easy to tune. Brings in distant stations on loudspeaker when conditions are favorable.
MA 15	Mu-Rad Laboratories, Inc.	$180.00	Six tubes, "A" and "B" batteries, loudspeaker and loop. Cost $70.00 to $90.00.	Transformer coupled radio-frequency	Loop	Sensitive and selective. One tuning control. Brings in local stations with plenty of volume and distant stations on loudspeaker when conditions are favorable.
Stromberg-Carlson	Stromberg-Carlson Tel. Mfg. Co.	$180.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Fully up to the best standards for neutrodyne construction. Three tuning controls. Will bring in distant stations on loudspeaker.
Type No. 59	Federal Tel. Mfg. Corp.	$193.00 Includes four tubes and headphones	"A" and "B" batteries, loudspeaker and antenna equipment. Cost $40.00 to $60.00.	Transformer coupled radio-frequency	Outdoor or indoor	Arranged for operation on storage battery. Sensitivity and selectivity may be adjusted to suit local conditions.
Type V	Garod Corp.	$195.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	In addition to the three dials used to control the tuning, there is a double range, high-grade voltmeter to test the condition of the batteries. Selective and sensitive. Brings in distant stations on loudspeaker when conditions are right.
Operadio	Operadio Corp.	$195.00 Complete	None	Transformer coupled radio-frequency	Self-contained loop	A portable set that includes tubes, dry batteries and loudspeaker. Brings in local stations with plenty of volume and semi-distant stations when conditions are favorable.
Radiola Super Heterodyne	Radio Corp. of America	$220.00	Six UV 199 tubes, "A," "B" and "C" batteries, loudspeaker. Cost $34.00 to $55.00.	Superheterodyne	Self-contained or external loop	Highly sensitive and selective. Two tuning controls. Gives loudspeaker results on distant stations.
Super Portable	Zenith Radio Corp.	$224.00 Complete	None	Tuned radio-frequency	Self-contained loop	A portable set that includes the loop. Can be operated without opening cover.
Super Zenith Model VII	Zenith Radio Corp.	$230.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor or loop	Highly sensitive and selective. Two tuning controls. Gives loudspeaker results on distant stations. Dry or storage batteries can be used.
D-14	DeForest Radio Co.	$371.50 Complete	None	Tuned radio-frequency reflexed	Self-contained or external loop	The circuit of this receiver is similar to the D-12 except that five tubes are used, giving the effect of nine tubes through reflexing. The cabinet contains storage "A" battery and dry cell "B" batteries. Highly selective and sensitive. Gives great volume on local and distant stations.

The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests appear elsewhere in this issue

Do You Want a Monkey Puzzle Tree?

In order to find out whether various alien immigrant trees will do well in this country the Forest Service of the United States Department of Agriculture has established tree farms or arboretums on which new kinds of imported trees that might possibly become public charges may be closely watched, so that if necessary they may be excluded from the United States.

For instance, the Forest Service is trying out the Japanese larch and the Chinese elm, as well as the African cedar and the Hindu soft pine. There is no way to find out whether a new kind of tree will make good in a strange land except to grow it there.

One such government tree farm is situated at Wind River, sixty miles from Portland, Oregon. Seventy-five foreign species of trees are now growing there under the eyes of the Forest Service tree experts.

One of these odd trees is the monkey puzzle tree from Southern Chili. Why call it such a peculiar name? Because it is said that it puzzles even a monkey to climb its intricately twisted branches. The monkey puzzle tree is a conifer (trees with seed cones), but its seed-bearing cones are very large. Sometimes they are eight inches broad and seven inches long. The leaves of the monkey puzzle tree are triangular and overlap like shingles, closely surrounding the trunk and branches.

This ornamental tree has apparently thrived well on the Pacific Coast, but must not be planted in exposed positions since the winds easily break the heavy, brittle branches, and thus the fine symmetry of form of the tree is lost.

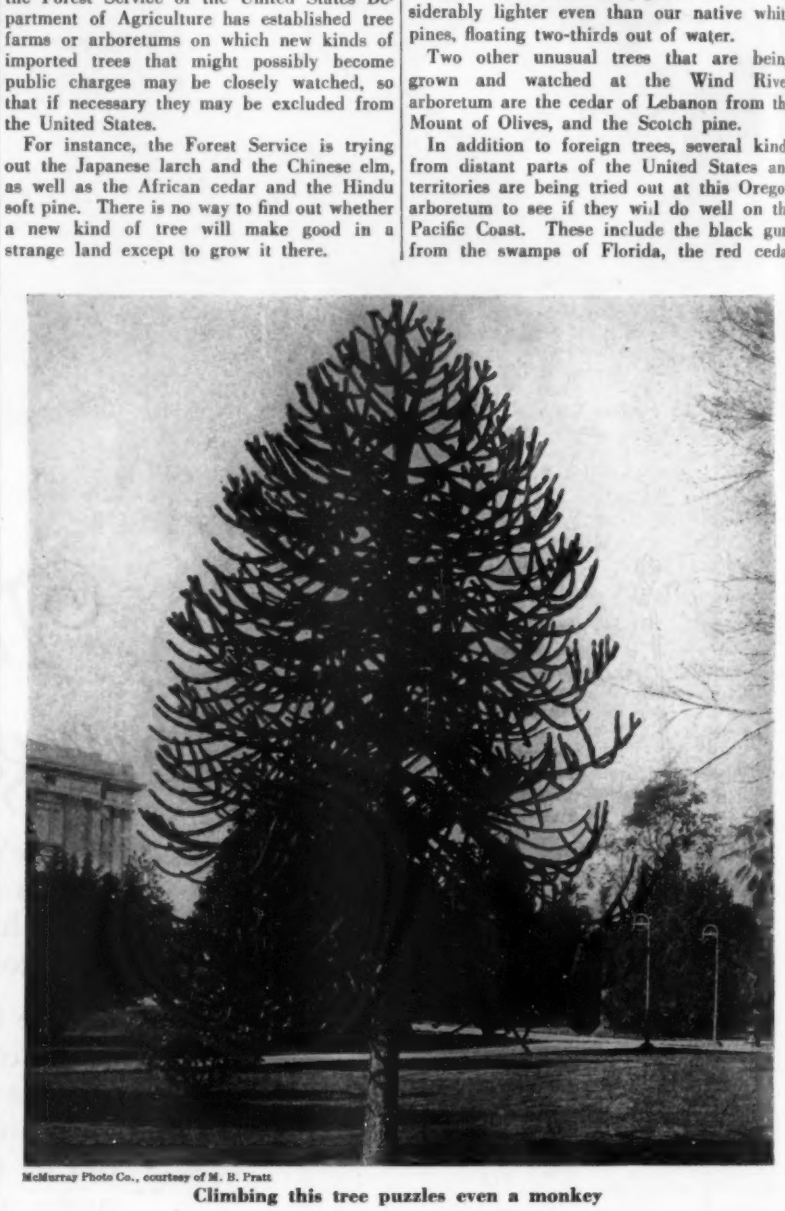
The wood of the monkey puzzle tree is considerably lighter even than our native white pines, floating two-thirds out of water.

Two other unusual trees that are being grown and watched at the Wind River arboretum are the cedar of Lebanon from the Mount of Olives, and the Scotch pine.

In addition to foreign trees, several kinds from distant parts of the United States and territories are being tried out at this Oregon arboretum to see if they will do well on the Pacific Coast. These include the black gum from the swamps of Florida, the red cedar from Virginia, the loblolly pine from Georgia, the Maine white spruce and the western hemlock of Alaska.

Many of these trees, perhaps never before having taken root in the Pacific Northwest, have found conditions to their liking, and are growing rapidly and thriftily. Two, however, have hardly grown at all. The white-bark pine has reached only to the height of five inches in ten years, while the Mexican pine has grown only an inch taller in the same length of time. Many others have failed entirely, due undoubtedly to unsuitable climatic conditions.

As the trees continue to grow they will furnish more information of value to foresters. —From statement issued by the *U. S. Forest Experiment Station*, Forest Service, U. S. Department of Agriculture, Washington, D. C.



McMurray Photo Co., courtesy of M. B. Pratt

Climbing this tree puzzles even a monkey

Preventing Oil Fires with X Rays

By the use of the X rays for examining the walls of the large stills in which petroleum or crude oil is broken up into heavy oils, light oils, gasoline, etc., the Sinclair Refining Company has been able to avoid many disastrous fires in its refineries.

Petroleum cracking, which is the process of breaking up the molecules of crude oil into some of the petroleum products with which we are all familiar, requires a temperature of about 750 degrees Fahrenheit. The stills in which this process is carried out hold from twenty-five to one thousand barrels of hot oil under a pressure of about one hundred pounds per square inch. Under these conditions any flaws in the steel containers are apt to result in failure, and from these failures fires result.

The weakest part of an oil-cracking unit is in the shell. Pitch and carbon coat the inside of these surfaces, insulating the oil from the fire, and preventing the oil which is inside from keeping the metal shell down to about the temperature of the oil. If there are any hidden flaws in the steel, a failure may result and the entire content of the still is discharged into the firebox below.

By means of physical, chemical, and metalographic tests for the study of the tubes, the life of such heaters or stills was extended three hundred or more percent, but that was not considered enough.

Following the recent development of the X-ray method of detecting flaws in metal this new technique was put into use for finding flaws, inclusions, porosities and cracks in the cast steel used for making the petroleum stills. The result was the elimination of castings having such defects, and the reduction of the number of accidents which has formerly been chargeable to them.—*Chemical and Metallurgical Engineering* (New York), vol. 31, pages 619-622, Oct. 20, 1924.

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Super-Pressure Boilers Made Like Big Guns

STEAM is to be used at the enormous pressure of twelve hundred pounds per square inch in the new 15,000-kilowatt Weymouth power station of the Edison Electric Illuminating Company (Boston). It will be generated in boilers of the modified Babcock and Wilcox type, whose cylindrical drums, four inches thick, four feet in diameter and thirty-two feet long, are solid steel forgings made with the same care as the guns of a super-dreadnaught. In fact, these drums were actually made in the gun works of the Midvale Steel Company.

Power will be generated by means of a turbo-generator of the General Electric Company, straight-impulse type, with twenty stages. The initial steam pressure in the turbines is 1,200 pounds per square inch at 700 degrees Fahrenheit. The exhaust pressure is 360 pounds per square inch.

Practically all of the development of high pressure steam is a matter of post-war history. At the beginning of the World War 250 pounds pressure per square inch was thought high. Today, 500 pounds is considered high, but the Weymouth installation mentioned above is considered extremely high. Still higher, however, is the Swedish experimental power plant using steam at 1,500 pounds per square inch, and the Benson plant in England, where the 3,200-pound pressure is reduced to 1,500 pounds for operation.

But the last two plants mentioned are more experimental than commercial, while the Weymouth plant is wholly commercial, and in that sense may be thought of as the present limit of practical pressure.—*Tech. Engineering News* (Cambridge, Mass.), vol. 5, pages 101-103, October, 1924.

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New Use for Hot Air

IN England where much of the climate is damp, recent experiments for the purpose of curing hay that is green, wet, or both, have shown that the farmer is not necessarily dependent on the whims of the weather for the success of his haying operation. The wet hay is stacked up around a cone-shaped wooden framework. Then hot air from a furnace is driven through it by means of a

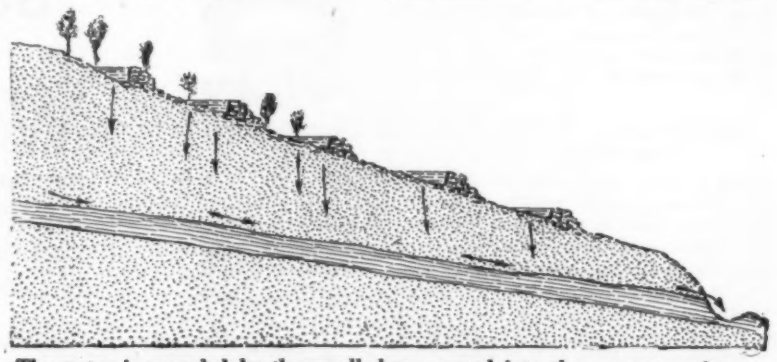
fan or blower driven from a farm tractor by means of a belt.

The framework on which the haystack is built up is made by placing half a dozen two-by-four scantlings about eight feet long in the form of an Indian teepee, and then wrapping woven wire fencing around this form. A length of large metal tubing is laid from the inside of the framework to a place well outside the edge of the future stack. This is for the purpose of delivering hot air to the haystack.

On a wagon are mounted a cube-shaped furnace about four feet high, having several internal baffleplates to keep the air from passing through before it is well heated, and a blower capable of handling five thousand cubic feet of air a minute. These are connected to the pipe under the haystack by means of a flexible canvas tube. The hay is next stacked quite carefully around the framework.

The power required to drive the fan is less than seven-brake horsepower. With the air heated to a temperature of from thirty to sixty degrees above that of the outside air, a twenty-five ton stack of wet, green hay can be cured in eight hours.

During the curing, the hay if wet smells like a wet dog and steams as if afire. A stack of mixed lucerne and rough grass thus dried from a green as well as a wet condition required but a day's fanning. Had it been left uncured it would have taken fire by spontaneous combustion, owing to the heat of its fermentation, quite shortly. When cured, the grass seemed as palatable and good as suncured hay.—*Engineering* (London), vol. 118, pages 554-555, Oct. 17, 1924.



The water impounded by the small dams seeped into the porous sandstone, issuing as a slow-flowing spring which supplied the ancient cliff dwellers with cool, filtered water during the rainless summers

Modern Engineer Copies Method of Ancient Cliff Dwellers

HUNDREDS, perhaps thousands, of years ago the cliff dwellers of what is now the Mesa Verde National Park of southwestern Colorado discovered a remarkable way to store up the water of the sudden, spring freshets.

Learning that water left in reservoirs would soon evaporate in the hot, dry air of the desert, these semi-civilized hydraulic engineers found a way to force the water into the pores of the rocks where it was safe from the attack of the summer sun. Thus stored, the water slowly trickled from the rocks, cool and crystal clear, providing an ample and continuous supply throughout the long parched summer.

Then came other tribes of red men, displacing the industrious cliff dwellers, but neglecting their clever engineering works. No more water oozed from the spongelike sandstone, for no more water was stored in it. Finally, the white man came, the Mesa Verde became a national park, but there was no water.

Recently the methods by which the vanished cliff dwellers stored water in the pores of the rock were re-discovered and the present Superintendent of the park could find no better way to get a constant supply of water than to clean out and use the hydraulic works of his ancient predecessors.

In several of the small steep creeks of the Mesa Verde there are ruins of many small dams not over five feet high, which were left by the early Indians. As the valley slopes are steep these dams could not have backed the water up more than a few feet. However, each stream has many dams, one above another like a stairway. In time of sudden flood the water in the dams must have made them resemble a chain of canal locks. In one canyon of this sort eighty-six of these small dams were found in a distance of a quarter mile.

At once the thought occurs, "How could the water that was caught in these dams be kept all summer? Would it not have quickly evaporated in the dry desert air?" The logic is correct, but the Indian knew how to turn this adverse situation into victory. He found that the water of the spring freshets soon seeped down into the sandstone on which the dams were built. It went down a vertical distance of something under two hundred feet. Then it met with an impervious stratum of shale and stopped.

The impervious stratum of rock had a slight dip, however, and the water, seeping slowly to one side through the spongelike sandstone all through the summer months when there was no rainfall, emerged at the exposure of the rock on the side of the canyons in the form of a slow-flowing spring.

When the purpose of these flights of little dams that still remain on all the steep stream courses had been re-discovered, Superintendent Jesse Nusbaum at once saw the value of the water-storage method which had been used so long ago by the early Indians. He set to work to imitate it. The heavy rocks of which the dams were built still remained in place and needed only to be chinked up.

Next summer, if everything goes as well as it did in the days of the ancient cliff dweller, the employees of Mesa Verde National Park will drink from a clear cool spring instead of from an alkali-laden tank of tepid water.—*American Forests* (Washington, D. C.), vol. 30, pages 654-657, Nov., 1924.

* * *

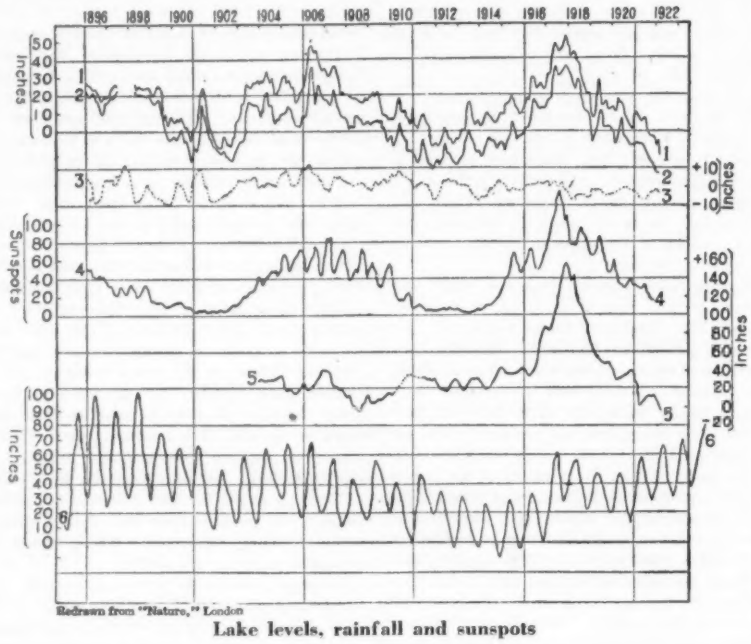
Unique Floating Toll-Road Across the Everglades of Florida

A PRIVATE toll-road fifty-one miles long has just been built through the Florida Everglades under conditions that are unique from an engineering point of view. Except where drained, the Everglades lie under water and the soil is soft, spongy, vegetable muck not capable of sustaining the weight of heavy vehicles. But underneath this quaking muck there lies at a depth varying from five to twenty feet a marl which hardens in the open air and makes an excellent road-bed or foundation when dug up, dried and spread out. The road is built of this marl so that, in one sense, the road actually floats on the underlying muck.

A great deal of the grading of this remarkable road was actually done under water, as the level of the neighboring Lake Okeechobee was then very high. The road even had to be protected from the waves of the lake by means of the dense water hyacinth which takes root in the lake and rapidly spreads, breaking up the waves quite effectually. Marl for spreading out on top of the muck as a solid road-bed was obtained by means of dredges which dug it up from the bottom of the St. Lucie Canal. This canal was already there when the road was begun. To make a roadway over the muck this material was piled up four feet high and about thirty feet wide.

The roadbed when completed was very substantial. The marl was dumped by the dredges into barges and conveyed along the future roadway to distances of as much as thirty miles. Then it was unloaded on platforms supported by piles and conveyed along each section of the road-building job by means of Ford trucks. However, on one portion of the road which skirted the shallow lake, it was necessary to distribute the marl by means of a special narrow-gage railway twenty miles long. Gas locomotives hauled the road-making material in dump cars. All trains ran under orders sent out from a train-dispatcher's office.

It is thought that in many places the heavy marl road-bed will gradually settle through the light muck to some extent during two or three years. Therefore, no expensive top dressing material has been put on the road at present. It was simply oiled. After the road has settled permanently, a rock top dressing will be put on and fully bonded together. Finally, this unusual toll-road, which was entirely financed and built by W. J. Conners, a Buffalo, N. Y., politician, was opened to the public on July 4, 1924.—*Engineering News-Record* (New York), vol. 93, pages pages 412-417, (Sept. 11, 1924).



Lake levels, rainfall and sunspots

Sunspots Affect Levels of Tropical Lakes

ONE way in which the coming and going of sunspots affect the earth's climate is proved clearly by recent investigations of their effect on the level of some of the large lakes of tropical Africa.

Whenever there has been a period of increased sunspot activity the level of these lakes has been raised. When, on the other hand, the sun's face has been relatively clear of sunspots the level of these lakes has gone down.

The close relation between these two phenomena is shown by a study of the accompanying diagram. Curves 1 and 2 relate to the lake levels. Curve 4 relates to the sunspot activity. The two curves rise and fall together with remarkable uniformity.

The reason why the lakes rise when the sunspots are greatest in number is believed to be because the sunspots decrease the amount of heat radiated by the sun. This results in a decrease in the evaporation of water from the lakes. Köppen has proved that the temperature of the earth's atmosphere in the tropics averages one and one-tenth degrees, Fahrenheit, cooler when the number of sunspots is greatest.

One and one-tenth degrees is not much difference in temperature, to be sure. But the effect of even so slight a change as this is sufficient to affect the lakes.

Whenever the atmosphere is warmed by twenty degrees, Fahrenheit, it is enabled thereby to about double the quantity of water vapor that it contains. A temperature rise as small as one and one-tenth degrees results, therefore, in the evaporation of an appreciably larger amount of water from lakes in regions where there is much sunshine.—*Nature* (London), vol. 114, pages 659-661, Nov. 1, 1924.

* * *

Remarkable Truck Economy Reported

TESTS of a motor truck that attained a fuel economy in excess of 100 ton-miles per gallon, were described in papers given by H. L. Horning and James B. Fisher before a meeting of the Mid-West Section of the S. A. E. in Milwaukee. The 2½-ton truck tested was fitted with a four-cylinder engine of four-inch bore and five and one-half-inch stroke, especially designed to attain maximum thermal efficiency and economy. The total weights of the vehicle and the load ranged between 8,300 and 16,000 pounds. The chassis was fitted with a van body having a frontal area of approximately 40 square feet. A standard transmission, double-reduction axle and solid tires were used throughout the tests.

Mr. Fisher stated that the engine used had a minimum fuel consumption of 0.48 pound per brake-horsepower-hour, and that the axle reduction had been selected to insure the operation of the engine through its range of greatest economy. Two routes were used for the test; one traversed typical country roads for a distance of 24 miles; the other route ran through city streets for four miles and included about a dozen stops. The country runs were made at a speed of fifteen miles per hour, and those in the city at twelve miles per hour.

A system of engine cooling was used where the cooling water is allowed to boil in the engine jacket and the steam drawn off and condensed in the radiator. Jacket-water temperatures of from 190 to 200 degrees Fahrenheit, are maintained with this system and Mr. Fisher stated that it resulted in better thermal efficiency, an increase of 8.8 ton-miles per gallon, in economy, and allowed an increase in the compression-ratio because of a more uniform cooling of the cylinder. Special aluminum pistons were employed and these, in combination with a combustion chamber form that promoted turbulence, allowed the compression-ratio to be raised to 5.5 to 1 without detonation being present. This higher compression resulted in a further increase in economy of 17.5 ton-miles per gallon. The engine valves were arranged to turn slightly with each upward movement of the valve so that they were cooled more uniformly. This added another increase in economy of 5.5 ton-miles per gallon.

After all of these refinements were made

the truck, with a load sufficient to bring the total weight to 16,000 pounds, ran 89.6 ton-miles per gallon, over the city course and 115.3 ton-miles per gallon, over the country course, according to Mr. Fisher. This remarkable economy was due to proper coordination of the units in the truck, increased thermal and mechanical efficiencies of the engine because of its higher jacket-water temperature and the employment of special forms of piston and combustion-chamber to allow the use of higher compression. H. L. Horning presented an analysis of the causes of detonation and explained how these theories had been applied to the design of special combustion-chamber forms, piston types and spark-plug locations to reduce the possibility of detonation in the particular engine used in the economy test.

* * *

Recent Excavations in Nebraska, Reveals Remains of Immense Indian City

In eastern Nebraska, along the banks of the Loup and Platte Rivers, excavations made last summer revealed that a great group of Indian settlements with at least a million population existed in the locality before the Pilgrims came to America. E. E. Blackman, curator of the Nebraska State Historical Society, has just made extensive excavations in this region and has established that the large settlements were in existence at least as far back as 1541.

Following the clue given in an ancient document in Paris, which described the massacre in 1720 of a Spanish expedition of several thousand persons, Mr. Blackman set out to dig for implements and other articles the Indians would have captured from the Spaniards. He found parts of Spanish plate armor and brass chains from the bits of Spanish cavalry horses.

Digging near Genoa, Nance County, Nebraska, on the site of a large, low Indian mound Mr. Blackman found evidences that a large settlement had once existed there. Heated underground rooms, circular in shape and as much as sixty feet in diameter were found. Under the former earth floors of these rooms were ashes, human remains, flint implements, broken pottery and other relics. In the same locality the remains of an Indian city of hundreds of thousands of inhabitants were discovered by means of a trench dug across an extensive Indian mound. Wooden posts which had entered into the construction of these houses had rotted away but the pockets in the earth where they had stood remained still open.

This ruined Indian city evidently dates from about the year 1541, reference to it having been made in the records of Coronado's great expedition of that date. Other indications tend to show its age to be at least two centuries older than this. Evidences that systematic agriculture was practiced by the Indians of this time and locality is shown by the discovery of many corncobs. Corn was raised in fields outside the settlement.—*New York Times*, Oct. 7, 1924, page 16.

* * *

Hunting New Fruits to Introduce Into the United States

The agricultural explorer is the name given to a scientist who is sent out to little-known parts of the world by the United States Department of Agriculture in search of new fruits and plants that may be introduced into this country.

One member of this unique profession, Wilson Popenoe, Acting in Charge U. S. Bureau of Plant Industry, has located in Ecuador an interesting group of fruits, many of which may become common in parts of the United States in future years.

One of these promising fruits, the cherimoya, is described as vegetable ice-cream, because of its white flesh, which has the consistency of a firm custard. It has the combined flavors of pineapple, strawberry and banana.

The Andes berry resembles a raspberry, while the fruit is like our loganberry, but less tart in flavor. Already the Andes berry has borne fruit in California and is doing well in the Gulf States and in the southwest generally.

The tasco is of the size and shape of a small banana. It contains numerous seeds, each surrounded by juicy, acid flavor. In Bogota, Colombia, housewives put this through a sieve and by adding sugar and milk make a delicious sherbet. The tasco has already been tried in California, where it has been found to succeed.

Other peculiar fruits discovered in Ecuador are of the capuli which resembles our own wild black cherry, the Chilean strawberry which stands shipping better than North American strawberries, but will not tolerate a moist climate, and the babaco, a large cylindrical fruit something like the common papaya.—*Natural History* (New York), vol. 24, pages 455-466, July-Aug., 1924.

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Could Professor Goddard's Moon Rocket Fly at All Through Empty Space?

Critics of Professor Robert H. Goddard's project for sending a rocket to the moon, who have taken the position that in a vacuum such as exists in space between the earth and the moon the gases emitted by the rocket would have nothing to impinge upon in order to propel the rocket, will be silenced by recent experimental proof that this criticism is a fallacy.

Professor Goddard, head of the Department of Physics at Clark University, Worcester, Massachusetts, answered his critics by placing a revolver in a vacuum and firing a blank cartridge from it. Although the hot gases of the burning powder had no air to impinge against, the revolver recoiled on its prepared axis just as if it had not been fired in vacuum. Further experiments along this line were made with a small model of the rocket which it is planned to send to the moon.

The rocket and a mechanical pressure registering device were placed in a long, specially constructed tank made of twenty-four feet of metal pipe of large diameter. The pipe was bent into a circle to prevent the rebound of gases expelled from the rocket from getting a possible push against any dead-end surface. When the pipe had been exhausted to one fifteen thousandth of atmospheric pressure the rocket was set off. The pressure registering device indicated not only that the rocket did not depend at all on the presence of an atmosphere to push against but that a rocket exerts twenty percent more lifting power in a vacuum than in the air.

Professor Goddard never expected his rocket to get its kick from the impact of its escaping gases against air or any other thing. On the contrary, its propulsion through the vacuum of space depends on Newton's Third Law, which states that, "To every action there is an equal and opposite reaction." When you strike out smartly with your fist into the air the backward impulse you get does not come from striking the air. Similarly, the faster the escape of the gas from the rocket the more reaction or kick the rocket gets.

The velocity of gases escaping from rockets is ordinarily extremely high, as familiar velocities go. Still further, the special design of Professor Goddard's rocket will provide for extremely high velocity of the escaping gas. In order to take the rocket past the point where the gravitation of the moon pulls on it more strongly than the gravitation of the earth, a velocity of about seven miles a second must be given to the rocket.—*Discovery* (London), vol. 5, page 235, Oct., 1924.

* * *

Above the Earth and Under the Sea

A new altitude record for airplanes was recently set by the French pilot Callizo. He reached the height of 39,580 feet above the earth. At this height he observed a temperature of sixty-eight degrees, Fahrenheit, below zero.

A short time ago the deepest spot yet discovered in the ocean was located by the Japanese surveying ship "Manshu," about 154 miles southeast of Tokio. Here the depth was found to be 32,636 feet, or about six and one-fifth miles. Until this recent discovery the deepest part of the ocean known was in the Pacific ocean, not far from the Ladrone Islands, the depth at this spot being 31,614 feet.

The 20-mule Team, Borax, and the Tractor

USERS of 20-mule team borax will be interested to know that nowadays the twenty-mule team is only a prosaic sixty-horsepower tractor of the tracklaying or tank type pulling six or seven broad-tired wagons behind it. The borax is the same, however, even though the old mules have been paid off and discharged.

Recent years have seen an increase in the number of commercially important discoveries of borax found. The importance of these may be judged by the fact that over 120,000 tons of borax is now being produced every year. Borax is not merely used to soften wash water, however, for it now goes into the manufacture of glass, enamel, household and toilet preparations, preservatives, fluxes, and various chemicals.

The borax deposits of the west are confined to Southern California and Nevada.—*Engineering and Mining Journal-Press* (New York), vol. 118, pages 419-422, Sept. 13, 1924.

* * *

The Center of the Earth

IT is now generally agreed that the earth consists of an iron core surrounded by silicate rock. The earlier speculations concerning the density at various distances from the center, it is true, proceeded on the assumptions that the earth is essentially uniform in composition and that the high internal density is due to compression under the great pressures in the interior. But, beginning with the hypothesis by Dana in 1873, the notion of an iron-cored earth has steadily gained credence among students of the subject.

What is certainly known is this: somewhere within the earth is a very considerable amount of material intrinsically denser than any known silicate rock. This conclusion is reached most directly from studies based on the compressibility of rocks and on the velocity with which earthquake waves are transmitted through the earth.

Such studies have yielded a quantitative estimate on the increase in density due to pressure at various depths and have shown that, while the effect of pressure on density is a factor not to be neglected, it is nevertheless impossible to explain the high density of the earth on the basis of compressibility alone. That is, there must be at the center some material which, under normal conditions, would be much denser than ordinary rocks would be.

The principal reason for assuming the dense material in the interior to be mainly metallic iron is the analogy with meteorites. Most of these visitors from outer space contain large quantities of metallic iron with varying amounts of nickel; and it does not demand an unwarranted use of the imagination to regard meteorites as fragments of disrupted bodies similar to, although probably much smaller than our own planet, and to reason that the structure and average composition of these bodies are not very different from those of the earth.

The earlier picture of the earth's metallic core, as presented by Wiechert, was that of a central iron core separated by a rather sharp boundary from the surrounding silicate shell. More recently it has been suggested that between the core and the shell lies a zone of mixed metallic iron and silicate rock, called pallasite from its supposed resemblance to a certain type of meteorites. The stony shell that surrounds the iron core is supposed to be granitic near the surface, and of basic (peridotitic) character below.—Abstract from article by L. H. Adams and H. S. Washington, *Journal*, Washington Academy of Sciences, Aug. 19, 1924.

* * *

Why British Colonials Turn to America for Motor Cars

EUROPEANS and Americans who live in the tropics or in various outlying colonial possessions want a motor car which has been designed especially for the very roughest kind of service.

"Yet," says Mr. F. A. Stepney Acres, in addressing the British Empire Automobile Conference, "the average British automobile manufacturer's idea of producing a colonial model is limited to packing up the springs about two and one half inches, perhaps stiffening them slightly, straightening out the center of the front axle, and leaving it at that. Small high-speed engines are quite unsuited to colonial conditions; that alone is probably one reason why the American manufacturer has ousted us."

Absolute waterproofness is essential to a car for tropical use. The vehicle must be able to ford streams without submerging the carbureter air intake, high-tension wiring or exhaust tailpipe. In the tropics the heavy rains suck through the radiator front. Therefore, the fan must be totally enclosed at the back.

Three-point suspension is absolutely essential in order to minimize distortion of the frame of the car, while the racking and twisting the radiator would otherwise get requires that it be spring mounted. To help get out of holes, a sprag must be provided. Tow rope hooks are needed both at front and rear. The running boards should be stronger, wider and removable, so that they may be used for getting the car out of deep mud holes.

In the not very distant future a wireless transmitting and receiving set will be a necessary part of the equipment at any rate for use in up-country districts in out-of-the-way parts of the world.

The car body, in the belief of this Englishman, should afford plenty of leg room because in such places as Australia, Rhodesia, and South Africa trips of several days' stretch are frequently taken.

In short, the car wanted by the British colonial, and this would apply likewise to the American colonial, must be capable of withstanding the most severe abuse, and of taking care of itself under all sorts of adverse conditions when hundreds of miles from the nearest repair shops.—*Automotive Industries* (New York), vol. 51, pages 286-290, Aug. 7, 1924.

* * *

Sackcloth for Cement

FOR several reasons the ordinary cotton cement sack is not entirely satisfactory, and cement manufacturers are now beginning to swing toward the use of bags made of jute fiber; even, in some cases, towards paper bags.

Chief among the growing objections to the common cotton bag holding ninety-four pounds of cement is its cost which in some cases has reached twenty cents. Paper bags cost but five cents and are not worth returning to the cement manufacturer. Much bother and work is saved when they are used. Cotton bags, when returned to the manufacturer of cement in repairable condition, are paid for at the rate of ten cents apiece. They then have to be repaired before refilling.

The importance of these considerations concerning the container for cement is due to the fact that we use over half a billion sacks of cement in one year. Since the average sack makes only a little over two trips from the factory each year it is necessary to have on hand a total stock of 250,000,000 sacks in order to handle the nation's demand for cement.—*Cement and Engineering News* (Chicago), vol. 36, pages 11-14, November, 1924.

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One House on Four Maps

THERE is one man in the United States, says *American Forests*, who is living in four different states at the same time. At the intersection of the four-square boundaries of Utah, Colorado, Arizona and New Mexico stands his ranch house. Therefore, he goes into Utah to sleep; when he gets up he washes in Colorado; next comes breakfast for which he goes over into Arizona; while if he finds any spare time he sits on his porch in New Mexico and has a smoke. His windmill pumps water for his stock from a well in New Mexico, but the trough from which the cattle drink is in Arizona.

Is this man a wag, or did he get his idea from seeing the record play, "Lightnin'?" To which state does he pay his taxes, and does he claim voting residence on a basis of the part of his house in which he sleeps or the part in which he smokes?—*American Forests* (Washington, D. C.), vol. 30, page 699, November, 1924.

Notes and Queries

Conducted by Albert A. Hopkins

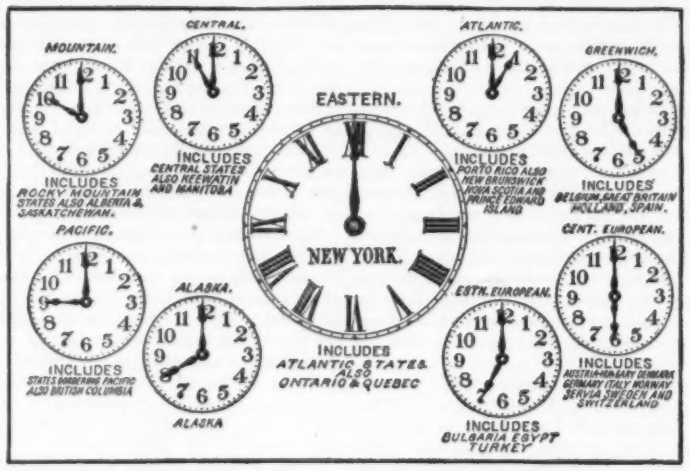
This department is intended for queries of general interest. Only a small percentage of the queries we receive can be printed here, the great majority being answered by mail. Except in special cases we cannot solve mathematical problems, give directions for building machinery or answer queries of a special nature which belong within the sphere of the professional engineer. All queries must give the name and address of the inquirer and must be accompanied by return postage. In writing about book orders or subscriptions please use separate sheets, give your name and address on each.

Chronological Terms Explained

D. J. G. *asks for information about the day, week and month which are generally left out of almanacs as being something that everybody knows and which the average man does not know.*

ANSWER: Measurements of time are based on the time taken by the earth to rotate on its axis; by the moon to revolve around the earth and by the earth to revolve about the sun. As these motions are not exactly commensurable with one another, it has become necessary to adopt average or mean intervals of time for ordinary use. Of these the first is the day which commences at midnight and is divided into twenty-four hours of sixty minutes, which in turn are composed of sixty seconds each. There are consequently 1,440 minutes or 86,400 seconds in a day. The hours are counted from midnight to noon when the count of one to twelve begins over again. Twenty-four hour reckoning is used in many countries and has distinct advantages as A.M. and P.M. are dispensed with. Great Britain will use this system beginning in 1925. With Jews and Mohammedans the day begins at sunset instead of midnight. The week is a period of seven days and contains 168 hours or 10,080 minutes or 60,480 seconds. The month is approximately one-twelfth of the year but the length varies. January, March, May, July, August, October and December have thirty-one days. April, June, September and November have thirty days. February has twenty-eight days except leap year when there are twenty-nine days. There are a varying number of hours, minutes and seconds in a month depending upon the number of days and the computations are easily made with the data furnished above.

The Jews and Mohammedans use the lunar month so that the number of days in a month varies, sometimes there are thirty days, sometimes twenty-nine.



Zones of Standard Time in the United States

Simplified Silver Cleaning

A. E. T. *writes us an interesting letter:*

In my magazine reading I find nothing so interesting as your monthly account of new inventions, and perhaps that is why it gives an especial fillip of pleasure for me to supplement the account of what you have labeled in your September number "Chemical Silver Cleaning." I have been using this method for some five or six years, and obtained my knowledge of it from that great source of general education, the daily paper, which gave a description of how to do it in the women's column. The so-called "silver cleaner" which you show in the picture is entirely unnecessary, if you use an aluminum kettle. Simply put in the salt and soda, and the silverware with each piece touching either the kettle or another piece. If you use an enamel or

granite-ware kettle—that is, as I understand it, a non-metal utensil—put in a small piece of copper and one of zinc, which can be obtained at any hardware store for a few cents, and have each piece of silver in contact with one of these or with another piece of silver. That is, the "chemical process" is only our old friend electrolysis.

I have a heavily decorated tea service that formerly never was clean, but now looks as if newly bought every time it is boiled.

Standard Railway Gauges

H. T. M. *asks for the railway gauges of the world.*

ANSWER:

In Great Britain = 4 feet 8½ inches.
In Ireland = 5 feet 3 inches.
In U. S. A. = 4 feet 8½ inches.

The 4 feet 8½ inches gauge is also used in Canada, France, Germany, Netherlands, Belgium, Denmark, Austria, Hungary, Italy, Switzerland, Sweden and European Turkey.

In Australia:

N. S. W. = 3 feet 6 inches and 4 feet 8½ inches.

Victoria and South Australia = 5 feet 3 inches.

Queensland and Western Australia = 3 feet 6 inches.

In New Zealand = 3 feet 6 inches.
In India = 2 feet 6 inches; 3 feet 3⅜ inches inches and 5 feet 6 inches.
In South Africa = 3 feet 6 inches.
In Egypt = 4 feet 8½ inches and 3 feet 6 inches.
In Ceylon = 5 feet 6 inches.
In Japan = 3 feet 6 inches.
In Russia = 5 feet 0 inches.
In Spain and Portugal = 5 feet 6 inches.
In Asia Minor = 4 feet 8½ inches and 3 feet 5½ inches.

The Heavens in January

By Professor Henry Norris Russell, Ph.D.

At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.
At 9½ o'clock: Jan. 29.
At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

NIGHT SKY: JANUARY AND FEBRUARY

ON THE map of the skies for January, we find the winter constellations full in the south—Orion half-way to the zenith, Taurus and Gemini higher. Auriga overhead. Canis Major low in the south, and, far down on the horizon, Canopus, visible only in the southern part of the country.

Leo is the principal star group in the east. Hydra in the southeast, and Ursa Major in the northeast. Ursa Minor and Draco are in the north. Cassiopeia and Cepheus in the northwest; Perseus, Andromeda and Aries in the west, and Eridanus and Cetus in the southwest.

Mercury is a morning star in Sagittarius, and is best visible about the 24th, when he is in elongation, twenty-four degrees east of the sun. Venus is a morning star, too, and is close to Mercury all through the latter half of the month. Jupiter is in the same part of the sky, and, on the 22d, all these planets are within a circle not much more than a degree in diameter. So close a conjunction of these bright planets is unusual and is worth looking at. All three, unfortunately, are south of the sun, and rise only an hour and a half before he does. They should all be visible in the dawn; their most dramatic appearance will be during the eclipse.

Mars is now an evening star, in Pisces, and sets a little before midnight. Saturn is a morning star in Virgo, and rises at 2 A. M. in the middle of the month. Uranus is an evening star in Pisces, and Neptune, being in Leo, is observable after midnight.

The moon is in her first quarter at 6 P. M. on the 1st; full at 10 P. M. on the 9th, in her last quarter at 7 P. M. on the 17th, new at 10 A. M. on the 24th (as seen from the Earth's center, but an hour earlier for us, during the eclipse) and back in her first quarter just before midnight on the 31st. She is nearest the earth on the 23d, and farthest away on the 8th.

During the month she passes by Mars on the 1st, Neptune on the 13th, Saturn on the 18th, Jupiter and Mercury and Venus on the evening of the 22d, Uranus on the 27th, and Mars on the 30th.

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin
Associate Professor of Aeronautics, New York University

Interest Centers Around the Light or "Baby Plane"

LIGHT planes, for several years a subject of interest in Europe, have now taken root in the United States, thanks mainly to the donation of $500 in prizes at the Dayton Air Meet. Since the material for building a so-called "baby plane" costs only $150 to $200, and the small twenty-horsepower engine about the same, it is possible for a home builder to turn out a very creditable craft for less than $500, using a woodshed or the local garage as his factory.

Sociable Two-Seaters

A MOTORCYCLE is an uncompanionable sort of craft without its side-car. Still more lonely is a solitary flight in an airplane, with nothing to break the monotony of clear air and blue sky. Accordingly light plane builders abroad are turning to the two-seater, with but very little more power and gasoline consumption than the single-seaters flown in the United States.

At the recent meet at Lympne, England, two-seater light planes were actually in the majority. The Short Satellite is one of these marvelous little, sociable craft. With a pilot and one passenger, it can fly at seventy-three miles per hour, yet its two-cylinder Cherub engine develops only twenty-five horsepower.

By courtesy of the United States Air Service

Lt. John J. Macready ready to fly in the original Wright biplane

Groups of such home builders, mechanics and young aviators, competed at Dayton. They achieved surprising results. Thus, a Driggs-Johnson plane equipped with a four-cylinder Henderson motorcycle engine attained a speed of 54.5 miles per hour over a twenty-five mile course, and showed a "cleanness" of design never surpassed by a large machine, not excepting the Pulitzer racers. H. C. Mummert of Garden City, flying another internally braced monoplane won an efficiency race of fifty miles burning considerably less than two gallons of gas in his flight of an hour and a half.

The London *Aeroplane*, describing the Satellite, lays particular stress on the fact that while metal construction is much more difficult for small than for large planes, this machine is very largely built of duralumin, with the fuselage covered with thin metal sheet instead of the usual doped linen fabric.

On page 56 the Satellite is shown with its wings neatly folded about a single pin on the sides of the fuselage, and tied together in simple fashion. In this condition, there is no reason why the little plane should not be stored in a small garage or proceed under its own power to a nearby landing field. The majority of the English planes at Lympne were provided with similar devices to increase their handiness.

By courtesy of the United States Air Service

Designer of the Driggs-Johnson light plane which won the first light plane event at Dayton

The 1925 model of such light planes should sell for not more than $1,500, and quantity production may reduce their price below that of a cheap car. Their tiny dimensions make them easily storable, without the necessity of large hangars. Owing to their lightness, they can have a very large wing area relative to their weight, and therefore, land slowly in contrast to the speed of an express train with which larger machines approach the ground. This makes them safe, and even the nastiest bad landing will damage the plane but will leave the aviator unscathed.

The *New York Times* points out that just as the advent of the "flivver" car alone made motoring accessible to all, so the "baby plane" may make flying universally popular.

Simplest Method of Obtaining Variable Camber

THE airplane builder knows quite well the advantage of variable camber for the wings of an airplane, lightly cambered for low lift and high speed in the air, heavily cambered for high lift and slow landing. But he has always hesitated to employ this

"I Want the Safety of an All-Steel Overland"

"I don't mind telling you—the thought of safety when driving a car, or before buying a car, occupies a big place in my mind. In fact, *safety* is one of the reasons why I so strongly favor Overland.

Knowing the new Overland models, both closed and open, have *all-steel* bodies, I *know* Overland is sturdier, and therefore *safer*. For I know that steel will withstand shocks that would destroy wooden coachwork.

The other day when I first sat in the driver's seat of the new Overland Sedan, I noticed immediately the vastly clearer vision a driver has. Steel eliminates the bulky wooden body posts that completely hide another car two or three seconds away. You have no idea how much safer you feel—and actually are—at the wheel of a new all-steel Overland.

I have sat at many wheels and looked a good many cars over carefully—but give me an Overland. In my eyes, there isn't a car anywhere near it in price that can begin to equal Overland in the comforts, conveniences and satisfactions it offers the owner.

I like the lustrous beauty of its finish. I like the ease with which I can steer it and park it. I like the thrill of its big power. I like the yielding depth and softness of its cushions. I like its smoothness over bumpy roads. And I naturally like its economy and low upkeep—it certainly is remarkably easy on gasoline, oil and tires.

Yes, I am buying an Overland—and I know I am going to enjoy every mile and every minute I spend in it. As I said before, I have looked them all over—but give me an Overland."

Steel construction, with narrow steel body posts, gives Overland drivers 50% more vision.

Danger lurks behind bulky, blinding wooden body posts.

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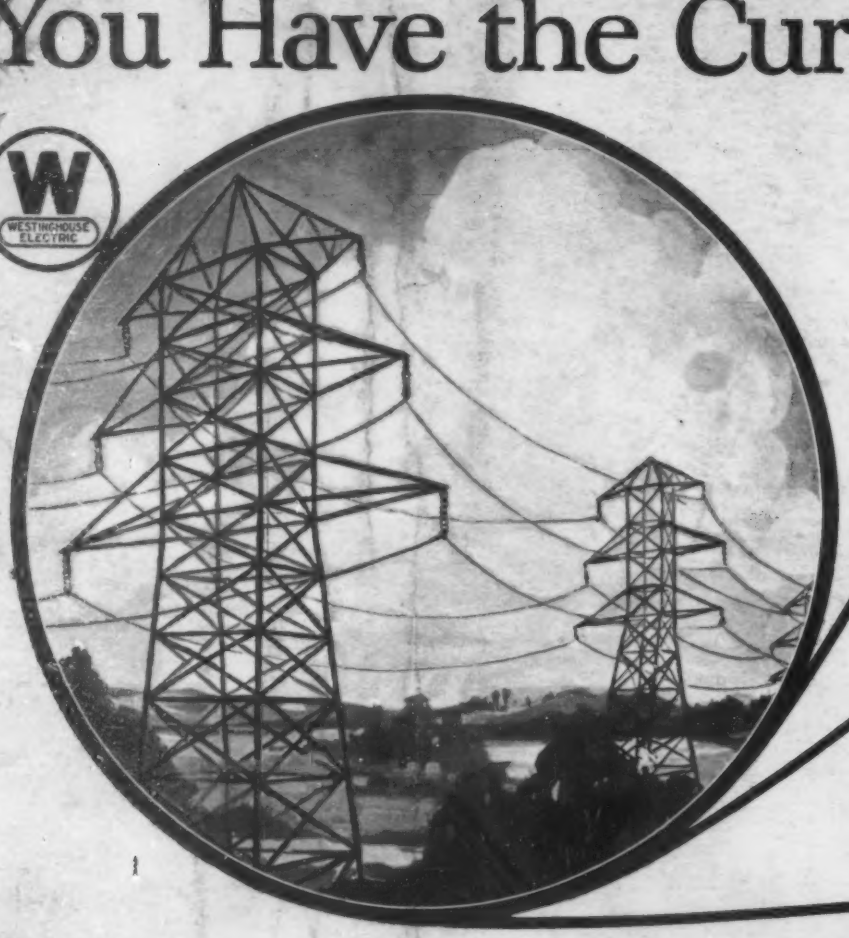
OVERLAND

A MOTOR CAR UNUSUALLY EASY TO STEER AND PARK

WILLYS-OVERLAND, INC. *have our endorsement. In dealing with them please mention* SCIENTIFIC AMERICAN.

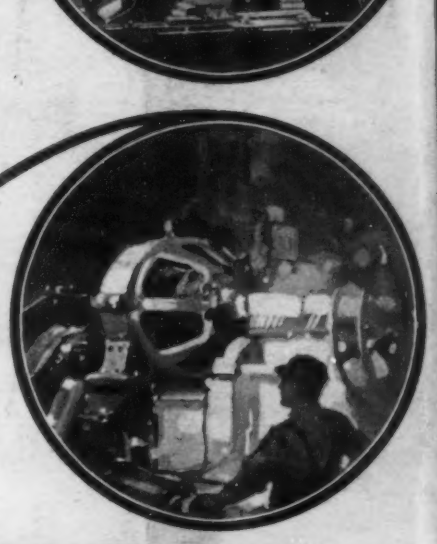
Printed in the United States, by ANDREW H. KELLOGG CO.

You Have the Current–



You are already using it for LIGHT

You are already using it for POWER



Use it also for HEAT

Use it because it can be *uniformly and automatically controlled*—giving you a better product, with less supervision.

Use it because it's *clean* — no dust or dirt.

Use it because it's *safe* — no fire hazard.

The astonishing progress of electric heat in industry is less in the lime-light, than is radio, or super-power, or motorization, yet it is as great an electrical achievement.

It bakes and cooks in restaurants, enamels automobiles, heat treats, melts and anneals steel, bakes cores for the foundryman and bread for the baker and finds new uses everywhere.

Individual manufacturers, Chambers of Commerce and Manufacturers' Associations will find it profitable to investigate the possibilities of electric heat. Westinghouse engineers will be glad to give the benefit of their pioneer work in this field to those interested.

Electric Heat is an occasional publication containing interesting descriptions of installations of electrically heated apparatus. Send for your copy today.

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Westinghouse

device, because it adds complexity to the construction.

The simplest method of obtaining variable camber is to extend the wing ailerons or rear flaps along the whole length of the wing, and by a differential mechanism to turn them up or down together, thus securing variable camber, or to turn them in opposite directions thus securing the usual aileron control.

The *Aeroplane* informs us that almost all the machines at Lympne, were provided with this device. When variable camber has become familiar on small machines, it will no doubt pass into current practice with larger aircraft.

Dispelling Fog

THE making of rain and the dispelling of fog have always been attractive but somewhat fantastic enterprises. For the airplane, fog dissipation at will would be of the greatest possible utility. It is scarcely to be wondered at, therefore, that the Army Air Service is lending its facilities in the shape of planes and pilots to Dr. L. Francis Warren, now of Harvard University, for experiments in fog and cloud dissipation.

As a result of three years' work, army pilots, using electrified sand discharged by centrifugal force through nozzles set in the under portion of the fuselage, have been able to disintegrate clouds at 13,000 feet over Bolling Field, Washington, D. C. The *New York Times* reports that the aviators described a circle above the cloud bank and that the circle was duplicated by a clean-cut pathway through the mist. But the clouds appeared to form again rapidly though at a somewhat lower level.

Pacific and Atlantic

Capt. A. I. Eagle of the U. S. Army at Bolling Field loading one of the tanks aboard his plane with sand before starting on tests to control fog

Dr. Warren describes the principle of his work as follows: "We base our work on the assumption that visible forms of moisture in the air, like mists, fogs or clouds are a form of colloidal suspension in gases and that they should be governed by the same general laws that prevail in colloidal action in liquids and solids. We fill the sand tanks on the planes with 120-mesh silica sand, the planes being equipped for charging the sand either positively or negatively by the turn of a lever. The sand impinging upon the charging plates or falling through charging nozzles is scattered by the air and driven back by the slip stream of the propeller. When a cloud is found to have a positive charge, we scatter negatively charged particles at the extreme top, and when it is found to have a negative charge we scatter positively charged particles. When it is found without any charge we first charge it as we like and then bring it down by again scattering particles of an opposite charge."

This brief explanation of the principles involved may perhaps be supplemented as follows: droplets of fog or cloud may be so small and their weight so slight that they cannot fall against the friction of the surrounding air; or else fall exceedingly slowly. But a particle of electrified sand will attract to itself great numbers of the oppositely charged droplets, and the resulting conglomeration falls very readily to earth.

Meteorological experts of the United States Bureau of Agriculture are not so hopeful of the process, and have in fact strongly attacked its inventors. They grant qualitative success, but are dubious of quantitative success. It is easy to attack a small fringe of a cloud but nature's vast strength may require hundreds of tons instead of hundreds of pounds of sand, and an enormous amount of electrical energy for operations on a large scale.

In reply Dr. Warren points out that the apparatus used so far has enabled the discharge of only thirty pounds of sand per minute. Given two or more large planes capable of discharging 1,000 pounds per minute, he claims that it would be entirely possible to disperse a fog over an area of 117 square miles—an area equal to that of the city of London, or of New York City and its harbor. The London Chamber of Commerce estimates the cost of fog to the city as $5,000,000 per day so that the expense of fog dissipation would be relatively negligible.

Besides its obvious utility in clearing an airdrome in case of fog, and its possible aid to farmers in period of dry weather, the process has many other applications. It seems wisest to reserve judgment and to continue experimentation on a larger scale.

Micarta Propellers

STEEL ships have almost entirely displaced wooden vessels; the automobile is almost entirely built of metal; and the airplane is rapidly going in the same direction. The wooden propeller is also being displaced by forged duralumin. But curiously enough fibrous materials are now challenging the supremacy of metal in this field, by the development of micarta propellers. Thus, cotton-duck fabric impregnated with resin is found to give greater tensile strength, and far greater crushing strength edgewise than wood for the same weight.

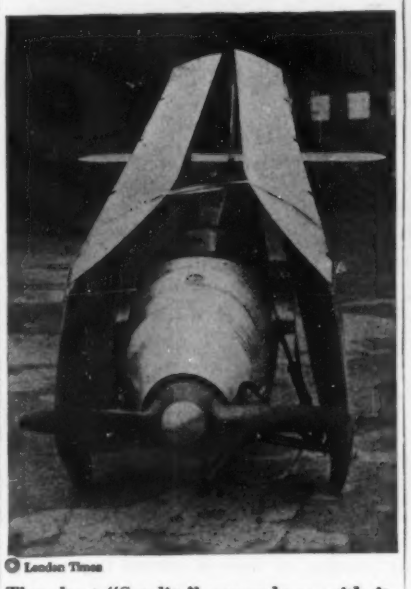
In the airplane propeller, the material is subjected to a very high tensile stress along the blade axis, owing to the tremendous centrifugal force acting on the rapidly rotating blades. Forces in other directions are not so great. Accordingly, the cloth is so selected as to have much greater strength in the warp than in the filler, illustrating that the most valuable property of cloth when used as an engineering material is that its strength can be made at will greater in one direction than in another, whereas

steel develops the same strength in every direction.

The cotton duck is prepared in thick rolls, cut to shape in laminations about half an inch thick, placed in a carefully fitted phosphor-bronze mold and subjected to heat by steam and to tremendous hydraulic pressure. Micarta propellers, once the mold is there, can be made more quickly and accurately than wooden propellers, and due to the greater strength of the material, thinner, more efficient and lighter blades can be used. Enthusiastic supporters of such impregnated fibrous materials foresee their use in many fields of engineering, for car bodies and chassis for example.—N. A. C. A.

Aerodynamic Progress

NOTHING illustrates so wonderfully the progress of aerodynamics as the two photographs shown on page 54. One is that of the original Wright biplane (which Lieutenant John A. Macready flew before Orville Wright himself at the Dayton meet) with a mass of exposed wires, struts and other resistance-producing parts. The other, that of the Driggs-Johnson plane, in which the wing resting snugly on the fuselage shows not a single external brace, and where even the pilot's head is enclosed within the celluloid protected cabin.



© London Times

The short "Satelite" monoplane, with its wings folded back

The High Cost of Flying Coming Down

THE cost of flying is being studied just as intensively by the United States Air Mail Service as are the various technical problems of operation. When the Air Mail first started work, it used to cost two dollars to fly a mile. Its latest statistical record shows that when every item of fuel, repair, depreciation and overhead is taken into account it only costs $1.15 per mile to operate over the New York-San Francisco route, and this includes the cost of working the gigantic beacons, some of which are 500,000,000 in candle power. Since the mail planes only carry 500 pounds of pay load, this brings the cost to $4.60 per ton mile.

Colonel Paul Henderson, broadcasting under the auspices of New York University, predicts a cost of only thirty cents per ton mile in the near future, and a nation-wide connecting up of all commercial and industrial centers that are approximately 1,000 to 1,400 miles apart. For shorter distances the airplane does not show to equal advantage.

It is a curious fact, which Colonel Henderson also emphasized, that night flying is more efficient in the maintenance of schedules than day flying, in the ratio of 110 to 100. Flying at night, the pilot has not the slightest difficulty in following the route marked definitely by the beacons and lighthouses; by day he may misjudge the most familiar landmarks.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Austin C. Lescarboura

TUNING BY MEANS OF JACKS

AN automatic radio receiving set has just made its appearance on the market. This set is tuned merely by plugging in on the desired station, and then swinging the loop to the angle which produces the best reception. The six jacks of the set have been tuned to the desired wavelengths, at the factory, and the radio novice need have no better knowledge of radio than the ability to read the meaning of the six jacks and plug in for the desired station.

For stations in between the wavelengths represented by the jacks and for long-distance reception, an intermediate condenser is employed. Only three controls are used with this set, namely, the intermediate condenser, the filament control, and the stabilizer.

A LOUDSPEAKER EQUIPPED WITH A STETHOSCOPE

THE stethoscope in radio is by no means a new idea, but it keeps bobbing up every so often in some new dress. Just now we have the stethoscope served to us as an accessory for the loudspeaker.

A manufacturer of loudspeakers equips his instruments with one or more stethoscopes which can be used in place of the usual telephone receivers for tuning in. When the desired station is tuned in, a turn of the lever in the base of the loudspeaker cuts out the stethoscope and operates the horn. There is no plugging in and out of the set. The same lever also regulates the volume of sound in both stethoscope and horn.

WORLD TIME CHART

This convenient time chart has been circulated among the friends of Station WGY, the General Electric Company, Schenectady, New York. The figures after the names of the stations indicate the hours faster or slower than Greenwich Time, this time being commonly used by scientists as the standard. The center circle may be rotated, permitting a special setting of the chart for any desired receiving station

WHAT TO LOOK FOR IN FIXED CONDENSERS

FIXED condensers must have the following qualities in order to function properly in radio receiving circuits:

Compactness, to fit the limited space of a radio set. Accuracy and dependability, as many sets are dependent upon this for their efficient operation and wavelength range. Constancy, the value of capacity should not change as time goes on or with temperature variations, as the operation of the set would be materially changed.

Fixed condensers of the compact mica type are now widely used in receiving sets. They are used: (1) in series with the antenna circuit, to lower the wavelength range of the set; (2) in parallel with the antenna and ground, to raise the wavelength; (3) as a grid condenser; (4) as a coupling condenser in many of the popular circuits; (5) to bypass radio-frequency currents across telephones, batteries or transformer windings.

HUNDREDS OF PATIENTS ENTERTAINED DAILY

No better example of radio in the hospital is to be found than in the equipment of the Walter Reed Hospital in Washington, D. C. Hundreds of patients are entertained daily by means of the radio receiving set of the hospital, to which are connected nine hundred sets of headphones and five loudspeakers. Signals from local and long-distance stations are received on a five-tube neutrodyne receiver and amplified by a Western Electric amplifier. Thousands of feet of wire are required to connect up the individual receivers with the control room.

COPPER TAPE FOR INDOOR ANTENNAS

THE last word in indoor antennas is a woven copper ribbon or tape, which may be tacked up without detracting from the appearance of a room. This copper tape is readily and quickly handled, and provides maximum receptive surface with minimum bulk.

SUMMARY OF RESULTS OF THE RADIO CONFERENCE

RECOMMENDATIONS were made that ships be no longer required to maintain the 300-meter adjustment as required by international regulation. The allocation of marine communication allows ship communication between 600 and 1,051 meters, with wave bands provided for radio compass stations at 800 meters, and radio beacons at 1,000 meters, with suitable protecting bands on either side of these wavelengths.

The wave bands reserved for marine telephone, colleges and government use run from 1,051 to 1,579 meters. Wave bands from 1,579 to 1,817 meters were assigned to point-to-point and marine use with spark transmitters, CW and ICW, and 1,817 to 1,910 meters for use in point-to-point and marine, CW and ICW non-exclusive. The band of 1,910 to 2,500 meters is reserved for the exclusive use of marine communication on CW and ICW. The government wave band is between 2,500 and 3,150 meters. The broadcasting band has been extended to include 200 to 545 meters, and cleared of all other types of service.

Radio amateurs have been allowed to retain the wave bands previously assigned by the Department of Commerce with slight changes. They have been assigned 150 to 200 meters; 75 to 86.6 meters; 32.8 to 37.5 meters; 18.7 to 21.2 meters; 4.6 to 5.3 meters. These amateur bands are available for CW and ICW as well as telephone work.

Important recommendations were made with regard to the various classes of broadcasting licenses, so as to minimize interference, while permitting the greatest number of broadcasting stations to operate.

It was considered inadvisable for the Department of Commerce to take any steps to regulate or censor radio broadcasting programs. As for the question of super-power broadcasting stations, it was decided that special licenses should be granted at the discretion of the Secretary of Commerce, and that these licenses be granted on an experimental basis only and for such periods of time as the Secretary might determine.

Both transmitters and radiating receivers came in for consideration, with recommendations to reduce unnecessary interference from such sources. Other problems were also covered.

All in all, the Third National Radio Conference accomplished all that was expected of it, and far-reaching effects may be expected as a result.

REDUCING "B" BATTERY COSTS

ONE of the major expenses in operating the usual receiving set is the "B" battery. In the case of a one-tube receiving set the "B" battery is bound to last for a period of many months, even a year or more; but when we are dealing with multi-tube receivers the "B" battery is apt to be short-lived and therefore an expensive proposition. It goes without saying that the "B" battery expense item increases with the number of tubes employed. Nevertheless, a little care will go a long way towards keeping "B" battery expenses down to a minimum.

First of all, considerable care should be exercised in testing a "B" battery. Of course, it is necessary to determine just how good a "B" battery is at a given time, so as to decide whether to leave it in the receiving circuit or to replace it. In testing the "B" battery, no heavy drain should be placed on the battery, such as happens when testing it with an ammeter, a 110-volt electric light bulb, a piece of wire so as to observe the spark, and so on. Such tests drain the battery to a greater extent than several weeks of service. A good voltmeter, reading from 0 to 50 volts, should be employed. "B" batteries should be discarded when the voltage reading for a 22½-volt unit drops to 16 volts.

Another source of rapid "B" battery deterioration is to be found in defective tubes. Some tubes draw entirely too much plate current. This can be checked up by having the tubes tested at any radio shop equipped with a vacuum tube tester. Still another source of "B" battery deterioration is in the use of too many tubes. In some of the present superheterodyne receivers we find eight tubes operating on a single group of "B" batteries. Such practice places too great a drain on the "B" batteries, and causes them not only to become exhausted in very short order, but also to drop off from the rated voltage almost from the very beginning.

It is no doubt needless to warn against unknown makes of "B" batteries the performance of which may be more or less questionable. And, by the same token, it is useless to warn against standard makes of "B" batteries offered at ridiculously low prices.

HUMAN BODY ACTS AS CONDENSER

BODY capacity is one of the troubles which come to those who build their own sets and sometimes to those who purchase sets of questionable design. Body capacity or hand capacity is that property of the human body which makes it act as a condenser. Thus if a set is carefully tuned to a given signal, it may be noticed that the signal decreases in volume as the hand is removed from the tuning dial. This means that the capacity of the receiver was properly adjusted for that signal, with the body capacity of the hand included; but as soon as the hand was removed, the capacity was diminished by just that small amount but, nevertheless, sufficiently to detune the receiver.

To eliminate body capacity, which is highly objectionable, it is necessary to prevent the body capacity of the operator's hands from affecting the sensitive radio circuits, particularly the grid and plate terminals. The usual methods consist in placing the grid and plate circuits and components some distance back of the panel, or in the placing of a screen or shield between the operator's hands and the sensitive radio circuits and parts. This screen or shield generally takes the form of zinc or aluminum plates on the rear side of the panel, usually behind the control knobs.

In home-made receivers the practice is to use tinfoil, shellacked to the rear side of the panel. The shielding is connected with the ground binding post, so that all body capacity effects are diverted before they can reach the sensitive radio circuits.

A manufacturer of hard-rubber products has recently introduced panels in which the anti-body-capacity shield, in the form of fine wire mesh, is imbedded in the panel material.

THE NEUTRODYNE GAINS IN POPULARITY

CONTINUED popularity of the neutrodyne is shown by the recent statement of R. T. Pierson, president of the Hazeltine Corporation which controls the neutrodyne patents. Mr. Pierson estimates that the manufacturers of neutrodyne radio apparatus expect to do a combined business of $21,365,000 from October 1, 1924, to April 1, 1925.

It is stated that according to three questionnaires broadcast during the past summer by an independent radio trade journal for the purpose of determining the relative popularity of various types of receiving sets, the demand for neutrodyne receivers is placed at fifty-two percent of all radio receiving sets sold, while the regenerative sets amount to thirty-seven percent and all other sets at about eleven percent.

We suspect that these figures are no longer accurate at this time, since it is only during the past few months that the superheterodyne has been widely marketed. However, they are presented for what they may be worth.

A POWERFUL CANADIAN STATION

WITH a new layout of apparatus, the CKAC broadcasting station of *La Presse* of Montreal, Canada, should be heard far and wide. The new transmitter employs no less than fourteen tubes of the Mullard type, each of 2,000-watt rating, namely, one power amplifier, three oscillators, four modulators, and six rectifiers.

A feature of this new set is that the energy, before going to the modulators, is treated to three-phase double-wave rectification by means of the six tubes mentioned. No motor-generator is required and tube rectification insures absolute tone purity. The rating of the aerial energy is approximately 25 amperes.

LOSSES THAT "LOW-LOSS" PARTS OVERCOME

LOW-LOSS parts are talked of more and more these days in connection with the highly efficient regenerative sets.

In the case of the low-loss condenser, the losses which have been overcome are those due to leakage, series resistance, and dielectric absorption. Leakage in the usual condenser is brought about by poor, misplaced, or too much insulating material. This has the same effect as though a high-resistance grid leak were placed across the variable condenser. Naturally, the signals are weaker and the tuning becomes quite broad, with one station overlapping another.

Series resistance, on the other hand, is caused mainly by poor contact with the rotary plates and by the use of poorly stamped spacing washers. In low-loss condensers series resistance is overcome through the use of pig-tailed contact with the moving plates and by machining the spacing washers to mechanical accuracy. Some manufacturers solder the stator plates together and also the rotor plates.

Dielectric absorption represents the losses brought about by the insulating medium. Bakelite, formica, celeron and various kinds of fiber have a high dielectric absorption loss, while quartz, pyrex glass, porcelain and hard rubber make excellent insulators. In overcoming dielectric absorption loss the practice is to use hard rubber insulation rather sparingly, with a minimum area of contact to the two plate members and to separate the points of contact as much as possible.

In variometers and other "less-loss" apparatus the main idea is to reduce the resistance and capacity effects in every possible way.

HOW TO INCREASE THE EFFICIENCY OF THE NEUTRODYNE RECEIVER

WHILE it is not advisable to tamper with the factory-built neutrodyne receiver, a set built or assembled by the radio enthusiast may afford the basis of considerable experimentation for those so inclined.

According to Charles Manley of the Eagle Radio Company, "low-loss" condensers may be adopted with a gain in efficiency. The primary windings of the radio-frequency transformers may be increased by several turns, with a still further gain of efficiency, but if the set then oscillates after it is re-neutralized, some of these added turns must be taken off until oscillation is checked.

Another method of making this type of set more sensitive is to underbalance it by lessening the capacity of the neutralizing condensers. These may be set for a maximum of regeneration, at which point there will be little or no oscillation. This point will be found to vary slightly at different frequencies. Another method of securing regeneration is through the use of a "linking" circuit. Three or four turns of wire are wound over the secondary of the second neutroformer, and this coil is connected to a similar coil placed in relationship to the third neutroformer, but the position of this latter coil must be variable in the same manner as the ordinary "tickler coil." The best method, however, of securing regeneration in this type of receiver is by placing a variometer in the plate circuit of the detector, thus applying the tuned-plate principle. It is necessary only to remove the plate wire from the terminal of the detector socket. This wire is connected with one terminal of the variometer, while the other variometer terminal is connected to the plate terminal of the detector socket. In practice such a device should be kept external to the cabinet and at a distance of a foot or more from it, in order to avoid any undesired reaction between the variometer and transformer windings.

DISTORTION AND ITS CAUSE

IN the usual amplifying transformer the voice currents are transferred from one circuit to another through a magnetic field. These two circuits are not conductively connected.

Before the days of broadcasting, amplifying transformers were purposely made to have an audio resonance around 1,000 cycles, so that the prevailing spark frequencies used in radio telegraphy would have free passage through them. But telephony deals with many frequencies simultaneously, so that it becomes necessary to eliminate resonance from the transformer. Resonance in the transformer allows one or a few frequencies to come through much more easily than others, causing great distortion. If two or three stages of audio frequency are used, any distortion occurring in the first stage is amplified by the succeeding ones, in addition to whatever distortion these succeeding stages introduce.

Resonance, continues Pearcy W. Mack, vice-president of a well-known firm engaged in manufacturing radio transformers, is a friend only while the energy exists at radio frequency (example, tuning and selectivity) and a foe while it exists at audio frequency (example, distortion).

WARNING TO BATTERY MANUFACTURERS

THE Bureau of Standards has issued a warning that manufacturers of radio batteries must not use the Bureau's name in connection with the sale of their products.

"The attention of the Bureau of Standards has been called several times to the unauthorized use of its name in connection with the sale of dry batteries for radio receiving sets. No test results of competing brands of batteries have been published. Statements that the Bureau has declared any particular brand to be the best or that it has rated certain brands above others are, therefore, unwarranted. The tests which have been made at the Bureau of Standards were primarily for the information of government departments, and assistance has been given also to the various manufacturers who have cooperated in the conferences and tests. Without publishing competitive test data, the Bureau's work has been helpful to the public also," concludes the statement.

IRON-CORE AND AIR-CORE TRANSFORMERS

THERE are two types of radio-frequency transformers. In the one type an iron core is used, and in the other an air core. The iron-core type of transformer can amplify over a broad band of wavelengths. This means that although one station may be broadcasting entertainment on a wavelength of 220 meters and another on 495 meters, the iron-core type of radio-frequency transformer will amplify more or less on both wavelengths and on intermediate wavelengths. But the amount of amplification thus secured, while uniform over the entire band, is limited.

The air-core radio-frequency transformer is a remarkable amplifier of radio waves—but only over a very narrow wavelength band. Within this limited sphere of usefulness it is a better amplifier than the iron-core transformer. An air-core radio-frequency transformer which is designed to amplify energy received on wavelengths of 360 to 400 meters, will be inefficient on lower or higher wavelengths. This is the reason why many old receiving sets which once gave much pleasure to their owners before the new allocation of wavelengths, are no longer capable of receiving, with the accustomed clarity, stations to which new wavelengths have been assigned.

AVOID SHORT CIRCUITS ON BATTERIES

ONE of the commonest causes of what seems to be poor service from radio batteries, both storage batteries and dry cells, is the fact that by some carelessness in handling a short circuit has been formed for a few moments across the terminals of the battery. For example, if the two terminals of a dry cell are allowed to touch against some metal object, such as the iron rail of a railway car platform, for even a few minutes, the cell will be ruined. All of its energy will escape uselessly through the short circuit.

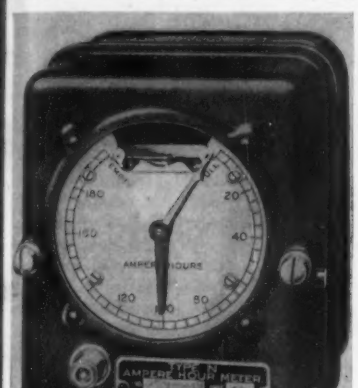
In the case of storage batteries, not only does the energy escape but the very high current produced inside the battery by such a short circuit sets free a great deal of heat. This may cause the lead plates of the battery to buckle, which will ruin the battery. It is unwise, even to test the battery by a momentary contact of a piece of metal to the two terminals, as many fans do. The use of a voltmeter is much safer as well as being more satisfactory.

HOW INTERFERENCE MAY BE LESSENED

COMBATTING radio interference is the subject of an interesting article recently written by Prof. L. A. Hazeltine, well-known radio engineer and inventor, who is best known for his neutrodyne circuit.

According to this recognized authority, radio interference may be lessened by the following means: The elimination of unnecessary electrical disturbances at their sources; the substitution of continuous wave for spark telegraph stations; the arrangement and operation of other stations so as to maintain the purity of their waves; the increase in the power of broadcasting stations (particularly if these are located away from densely populated sections) to swamp static and other interferences; the design of radio receivers so as to be as selective as is practicable, technically and economically; the substitution as far as possible of non-radiating receivers for the radiating types, and finally the education of the user of radiating receivers.

Progress is being made in each of these lines of attack, Prof. Hazeltine assures us, and we may confidently look to the substantial subjugation of radio interference in the not distant future.



This new meter records ampere hours instead of amperes. It is designed to indicate automatically the degree to which a radio storage battery has been exhausted, so that a re-charge may be made in time to avoid damage

CONVENIENT METER FOR SET USERS

NOTHING is more exasperating than to discover at the critical moment when you ask the family to listen to your receiver that the storage battery has run down and that there will be no program for anyone to hear. Frequent tests of the battery acid with a hydrometer is a partial protection against this disaster; a habit of nightly or weekly charge for your batteries is another.

But possibly the most convenient way of all to keep tab on the condition of a radio battery is a new meter devised and marketed by the Sangamo Electric Company. This meter reads in ampere hours. As the charge of a battery is used the hand of the meter progresses gradually around the dial. One glance at the meter shows just how nearly the capacity of the battery has been exhausted.

For use with batteries of less capacity than the full limit of the meter dial a movable red pointer is provided. This can be set at the danger point for any given battery. As the black, use-recording pointer gets close to the red one the set owner knows that it is time to recharge. The high reputation of the Sangamo instruments in the field of electric meter work is a sufficient guarantee that the new ampere-hour meter will be of the best workmanship and electric design.

ECLIPSE COUPON

The report of your observations of the eclipse of the sun on January 24th, as described on pages 14 to 16 of this issue may be sent in on this coupon. Or, if you prefer, you can write a letter with your answers. In the latter case be sure to answer as many of the questions below as you can.

Read carefully the directions printed on pages 14 and 15 of this issue. Do this now, well before the date of the eclipse. If there is anything that you do not understand write to the Editor of the Scientific American for further explanation.

Mail your report—whether on this coupon or in a letter—to either one of the following addresses:

The Editor, Scientific American, 233 Broadway, New York City — or — The National Research Council, Washington, D. C.

Do not forget to put your own name and address on the report so that we can ask you for further information later should that be necessary.

Full information about the times and places of the eclipse will be found on pages 14 and 15 of this issue.

Question 1. *If the sun is not quite eclipsed at your station there will always be a bright edge of the sun visible, or perhaps only a single point. One bright point may appear on one edge of the sun before the other has entirely disappeared. At your station was there any time at which no bright edge of the sun was visible? Answer YES or NO.....*

Question 2. *If the bright edge of the sun entirely disappeared, how many seconds elapsed before another bright part of the sun became visible? Answer.....seconds.*

Question 3. *Was the time set down in the last question merely guessed at or was it actually measured? If measured, how was the measurement made?.....*

.....

Question 4. *The fringe of light surrounding the sun and called the corona (see page 15) is fully visible only if the face of the sun is entirely covered. At your station was there any time at which you could see the corona all around the sun? Answer YES or NO.....*

Question 5. *Could you see any stars or planets at the time when the sun was most completely covered and how many did you see?.....*

(If convenient, draw a little map showing the positions in the sky of the eclipsed sun and of the stars and planets that you saw.)

Question 6. *If you are on a high building or a hill near the edge of the shadow path you may be able to see the shadow advancing across the country. If so, what buildings or other landmarks were inside and what were outside the edge of the shadow?.....*

Landmarks inside the shadow: .....

.....

Landmarks outside the shadow: .....

.....

Question 7. *It is necessary to locate your position very accurately, so that the engineers who compute the reports will know just where to place your observations on the map. Accordingly, give your position by means of the nearest street intersection (if in a city or town) or by means of some easily located building such as a railroad station, a town hall, or some landmark which can be placed easily on a map by a person familiar with the district*

.....

.....

If you have a map of your district, published in a newspaper or from any other source, mark a cross on the map at the position where you stood and send in the map with your report.

NAME .....

ADDRESS .....

We will be glad to send separate copies of this coupon to anyone who intends to observe the eclipse. Write the Editor, Scientific American, 233 Broadway, New York, N. Y., and ask for them.

The Psychic Investigation

(*Continued from page 29*)

"Pause. 9:14. Houdini says the cabinet is shaking and oscillating.

"Pause. 9:15. Victrola stopped again. Walter also disclaims the stopping of the victrola the second time.

"Pause. 9:18. Bird says megaphone is sliding around the floor. Controls: Houdini, O.K., Bird, O.K. (O.K. means as previously dictated.)

"Pause. 9:21. Bird reports sharp movement of the cabinet. All three controls O.K. as previously described.

"Pause. 9:23. Bird says that he investigated the distance from Psychic's elbow to the cabinet and found it to be from eight inches to a foot.

"Pause. 9:25. Bird says there are some raps that seem to be connected in some way with Psychic's chair. He says that he has control of all of her fingers as well as her hand in general on this side. The raps continue he says. Walter says, 'It's very simple, it's simply the cabinet banging the arm of the chair.'

"Pause. 9:29. Bird says the cabinet is moving up on him from behind and is now in contact with him. Controls all reported perfect.

"Pause. 9:34. Houdini says the cabinet, his edge of it, has gone some distance away from him, and Bird says that his edge has approached him more nearly. Controls have been maintained as formerly, that is, hands and feet of both Psychic and Dr. Crandon are all controlled.

"Pause. 9:36. Bird says cabinet falling in towards Psychic very much. 'Falling' is the wrong word, it should be 'folding.' Bird's wing is now between Bird and Psychic.

"Pause. 9:39. Comstock just went over and pinned the curtains across the door to the hall so that a faint light from the hall would not get in

"The cabinet has moved so far that in its present position neither Houdini nor Bird have been able to locate it by their usual method. All controls O.K.

"Pause. 9:40. By the sounds we infer the cabinet is still moving.

"Pause. 9:44. Bird says the table is moving quite a lot.

"Pause. 9:48. Conant says there is a slight pressure of the table on his leg. Continued pressure. A moment later it moved several inches away from him. Conant and Mr. Munn say the table went off its legs to some extent and went back in position again. All controls O.K. Bird's control is substantially as formerly, there is a slight difference, however, namely, that his foot is on Psychic's instead of beside it.

"Pause. 9:50. Houdini says the table is falling over on him. At present it is leaned up against him, that is it is on two legs. Bird touched by something that felt like a feather stroking up and down his little finger. It passed from his finger down his leg. Houdini verifies that the table is on two legs leaning against him.

"Pause. 9:52. Bird touched on the knee.

"Pause. 9:52½. There was a fairly loud sound of the table. Houdini says the table has dropped back again on four legs.

"Pause. 9:53. Another sound from the table, as if it had been raised off two legs and dropped back again on the floor. Mr. Munn says he felt this action of the table.

"Pause. 9:54. At Walter's suggestion the circle was spread out a little to give more room.

"Pause. 9:55. Table is being upset Mr. Munn says. Box dropped off the table onto the floor. This was at 9:56. At the instant when the table went over Houdini, Bird and Conant all report that all of their controls were perfect as previously described. Bird's foot still on top of Psychic's.

"Pause. 9:57. Mr. Munn says table moving. Houdini says he thinks the table is on edge now, that is with the legs horizontal.

"Pause. 10:03. At Walter's suggestion we turned on the lights for ten seconds and looked around. The table was generally the way it had been described in the dark, that is, it was tilted upward on Psychic's side. The cabinet looked very much smaller and had been moved back. From the hasty glance we had it looked as though it had been folded all together.

"Pause. 10:07. At Walter's suggestion the table was taken out of the circle, the contact locked box was put between Houdini's feet, the controls were all carefully inspected, and the lights were turned out at 10:10.

"Pause. 10:12. The contact apparatus suddenly rang, everyone reporting perfect control. The contact rang several times. Control as originally announced. Walter a moment later told Mr. Munn to sit up. Mr. Munn says at the moment he said that he was leaning over.

"Pause. 10:20. Bird has just changed his foot control. He now has Psychic ankle to ankle, his foot beyond hers, between hers and the box.

"Pause. 10:24. At Walter's request we turned on the light for five seconds.

"Pause. 10:27. At Walter's request the red light was put on for five seconds.

"Pause. 10:30. The contact apparatus rang one long peal. All controls reported perfect as previously. Half a minute later another ring. He (Walter) then asked Mr. Munn how many times he should ring it, Mr. Munn said five. He then rang, one, two, three, four, five. He then said 'Good-night.' We turned on the light to examine positions and controls, etc.

"Mr. Conant and Mr. Munn moved out of the circle in order to make room for a photograph to be taken of the Houdini-Psychic-Bird control. In order to do this it is, of course, obvious that the control of the right side of Dr. Crandon had to be sacrificed for the photograph. As stated, however, this control was maintained at the time of the sitting.

"After the sitting we examined the cabinet. We found that both the parts were neatly folded up together so that the whole thing was perhaps only four feet wide and pretty nearly flat. It was more or less symmetrically behind Psychic's chair a few inches."

(Signed) J. Malcolm Bird
G. F. Wood
D. F. Comstock
R. W. Conant.

"It is understood and specified by Houdini and Mr. Munn that in the event of publication of this document, it shall be published only *in full*, and that no abstracts, quotations, etc. from it shall appear singly.

"All the foregoing that came within my personal observation is correct."

(Signed) Orson D. Munn
Houdini.

"Just previous to the sitting I thoroughly searched the Psychic. She removed most of her clothes, and I examined her and then carefully. She wore a loose green linen dress into the seance room, and I examined this carefully before she put it on. She also removed her shoes, and I examined her feet and shoes carefully. She then put her shoes on again. She also took down her hair, which I searched.

"The search was conducted in the light and then I also searched her in the dark for luminous spots of any description. No such spots were seen."

(Signed) G. F. Wood.

These signed records speak louder than after-thoughts!

Now any one who has studied this subject knows that results vary directly as the amount of harmony among the sitters. We are constantly enjoined to be cheerful and relax. The wonder is that there has been any semblance of success considering the atmosphere of distrust, criticism, and hatred that has been exhibited by the committee.

The reason for the delay in our report has been the hope that before now your committee would show a truly scientific and judicial attitude by disapproval and disavowal of certain acts by some of its members. This has not been done. We are not personally aggrieved at our

judges: we are fond of them, indeed! Each has an attractive personality in his own way. After our long experience with them, however, we do feel justified in reciting some of the things we have endured with a smile.

The November report covers more than ninety seances, at which we have submitted to every condition of control suggested. At each of the seances two or more committee members have been present. Of these sittings we have their signed notes. Practically always the expression, "control perfect" precedes and follows the description of phenomena. We have used their apparatus exclusively. Whenever requested we have sat in their quarters. Every condition of control, they have dictated. The members have testified in writing to the occurrence of thirty varieties of phenomena. These thirty varieties have been classified from the records by one of the committee.

Apart from the committee, first and last, one hundred and forty people have sat with us. They include ministers, doctors, lawyers, men and women of education and experience and of all creeds. Only one person has suggested fraud.

The committee's bell-box has been rung in the presence of Dr. McDougall, in red light, the box raised above the table and carried seven feet across the room, still ringing, by Dr. Elwood Worcester, and the space around, above and below the box thoroughly traversed by Dr. McDougall. The bell-box has been rung in daylight while the psychic's four extremities have been controlled by Dr. Prince, no other person being present. The box was in Dr. Prince's lap.

In spite of these evidential happenings Dr. Prince is still unconvinced, to the degree, at any rate, that he is willing to commit himself affirmatively. Frankly, we wonder if it is possible to convince him. We do our best to meet his conditions, only to be met each time by new conditions. Meanwhile the further development of this many-sided mediumship is being held up. One of the most important lines for investigation will be photographic in nature, and I submit, herewith, a recent picture taken under conditions apparently fraud-proof.

A short history of this picture follows: At one of the recent sittings there was an unusual exhibition of psychic light, so-called, and one of these luminous areas descending upon the flapper of the bell-box apparently caused it to ring. Thereupon Walter, the control, said: "Some night I will show you my hand pressing down the flapper of the box." On the evening of November 3, Walter said he was ready for the test, and the photographs were taken by an expert in photography from the Massachusetts Institute of Technology. He owned the camera and he brought his own plates. Everything being in readiness, Walter said to the operator:

"When I say the word, shoot; that is to say, fire your flashlight." The result was the picture reproduced with this article. Those who are familiar with psychic photography will notice the

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[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

similarity of this picture to those of other investigators, notably Schrenck-Notzing.

Following are the official records of a typical, to my mind, genuine and valid sitting:

The room was searched. The doorway was closed by a couch across the outside. The committee's stenographer was seated on the couch, her ankle tied to a leg of it.

Ediphone notes taken during the sitting of May 14, 1924, by Dr. Comstock, member of the committee.

"8:50 P. M. sitting commenced.

"Circle composed as follows: The Psychic, Dr. Crandon on her right, and proceeding to the right, Dr. Prince, Dr. Comstock, Dr. Carrington, and Dr. McDougall, the latter on Psychic's left.

"Mr. Bird was on the floor behind Dr. Crandon.

"Dr. McDougall had foot control of Psychic and her left hand, Dr. Crandon had her right. Mr. Bird had control of link between Dr. Crandon and Psychic and of both Dr. Crandon's feet.

"9:00. Walter whistled. The control of the Psychic's feet by Dr. McDougall was tested by her attempting to withdraw one of her feet (at request of scientists) and it was found, as was expected, that the least movement was noticeable. Dr. McDougall said he was aware of the slightest movement of the feet. Her feet were between the calves of Dr. McDougall's legs.

"9:15. Red light contact made once. Mr. Bird was in contact with Dr. Crandon's back so that this couldn't have been done with his head.

"9:30. Pole fell down. Dr. McDougall said that at the time the pole fell he was sure there was no perceptible move of the Psychic.

"9:37. Cabinet began to creak and move slightly. Disturbance of the cabinet continued for several minutes, the control pronounced perfect during these movements.

"9:50. Cabinet moved slightly. The left wing apparently swung around at sharp angle. Red light for two seconds to examine cabinet.

"Cabinet had been opened out away from Dr. McDougall with back of the arc toward the door. It looked as if the two front edges of front of cabinet might be about eight feet apart. The corner of the cabinet at Mr. Bird's elbow remained more or less stationary, as it served as a pivot. The left end of the cabinet as seen from the door appeared in the red light to be six or eight feet away from the Psychic.

"Cabinet continued to move.

"Red light for two seconds.

"Part of the cabinet, presumably west wing, broken off and fallen to the floor.

"When the left wing was ripped off the cabinet there was distinct sound of tearing of the wood as it was being broken off.

"After the fall of the wing Bird got up and examined it, in red light, and said, "Rear left-hand corner stands a yard behind the Psychic and the back of the cabinet is at an angle of about thirty degrees with its original position. All the curtains are still attached to the standing parts of the cabinet.

(Signed) Hereward Carrington.
J. Malcolm Bird.
Daniel F. Comstock.
W. McDougall.

"Additional comments dictated immediately after sitting. Dr. McDougall dictated: During the destruction of the cabinet Dr. McDougall had the Psychic's left hand across her lap so that she could not be using her elbow and he says he would also have felt any movement of her body. We also proved after the sitting that it was too far away for her to move with her head by leaning sideways."

Later in the summer two sittings were held, the Psychic sitting in a box made by a member of the committee. The committee was denied examination of this box. The box was not even left in the committee's quarter over night. The owner of the box refused to leave it in Boston for further tests.

At one of these two sittings a "plant" was found which sought to prevent phenomena. At the other a "plant" was found, which, undiscovered till later, would have forever discredited the psychic. Whose was the motive and whose the exclusive opportunity to make these "plants," I will not name. No one in that room those nights had any doubt. Whoever made the "plants" is not interested in psychic research. All members of the committee present, who observed these acts without comment or disavowal, had, in my opinion, a duty as gentlemen, which still continues, to state frankly to the public what happened and the circumstances thereof.

Dealing with this delicate, sensitive, unknown psychic force, of which there have been intimations and manifestations since the beginning of recorded history, regardless of the possibility that certain conditions are requisite for exhibitions of this force, your committee has surrounded his mediumship with the acrid atmosphere of their distrust of each other and has forgotten entirely the psychology of the medium herself, who has to be a factor in every event. Your committee has forgotten the records it signed and presents a "report of progress," which is only noteworthy for its self-protecting vagueness. Emerson says: "The scholar shames us by his bifold life. Whilst something higher than prudence is active, he is admirable. When common sense is wanted he is an encumbrance. So in regard to disagreeable and formidable things, prudence does not consist in evasion or in flight, but in courage."

It gives us satisfaction, however, to declare that Mr. O. D. Munn, owner, and his editors, Dr. Free and Mr. Bird, have been unfailing in their courtesy and absolute fairness. We diffidently suggest, nevertheless, that Mr. Munn might approve a change of name for the committee to "The Scientific American Committee for the Prevention of Psychic Phenomena."

These phenomena have occurred, in our opinion, in the presence of your committee. The original proffer of award is made to one who, "To the satisfaction of the judges produces an objective psychic manifestation." As we read the official signed records of the committee, which will be made public sometime, we believe that this has been done in full measure and running over.

In view of certain newspaper headlines, we feel it necessary to reiterate that, at the onset of the investigation, the "Margery" mediumship disclaimed the money award, reserving only, if it were obtained, the right to direct its expenditure in psychic research. The question of money, therefore, need not be raised.

For the present we rest content with the positive results obtained by the committee. They may have originally come to scoff but for eight months they have continued to come, much interested. We do not propose to be diverted by mud-slinging or efforts of anyone to obtain

publicity. We are interested only in establishing scientifically the reality of psychic phenomena, quite apart from the cause thereof.

The kinds of manifestations of this mediumship include practically every variety recorded in modern psychics. The proved independent voice promises a psychic phenomenon and it then occurs as promised, under most severe conditions. The unthinking person says, "Why these trivial performances?" Well, the falling of the apple was trivial, but it meant gravitation to Newton. So the fraud-proof, sharply limited, localized bell-box rung in the full red light, a requested number of times—means an intelligent psychic force. I venture to prophesy that this case will go down in the history of the subject as one of the greatest.

Other coincident observations of the mediumship are going on under proper test conditions. The new observers are persons of repute, of unquestioned integrity, interested only in the truth, whichever way it points. The Society for Psychical Research of London is also starting a study of the case.

Fortunately a fact is a holy thing and must fit in a universe of truth. The truth lying in the facts of this mediumship does not depend upon the peculiarities or prejudices of any judge. Honest conservatism and slow-going care in the investigators is no reproach to them. But let them not forget the splendid courage of Galvani, in 1762, who said: "I am persecuted by two classes: the scientists and the know-it-alls. Both of them call me 'the frogs' dancing-master.' Yet I know that I have discovered one of the greatest forces in nature." We ask them only to keep before them the commandment: Thou shalt not be guilty of intellectual dishonesty.

Science Notes

Foot-and-Mouth Disease Almost Beaten in the United States

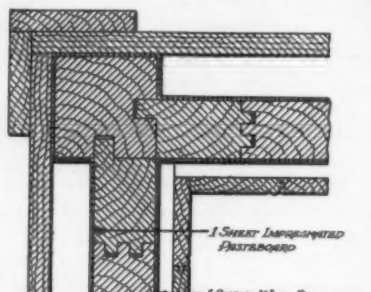
THERE is now little fear from the recent outbreak of foot-and-mouth disease in California. The Department of Agriculture states that the only place where infection from this disease of cattle is still suspected is in the Stanislaus National Forest in Tuolome County, California. A number of herds of cattle have been grazing in this forest region. It lies in the Sierra Nevada Mountains in a general easterly direction from San Francisco. Even there, however, only a very few cattle were infected. Twelve large herds which were removed from the Stanislaus Forest were thoroughly inspected and no symptoms of foot-and-mouth disease were found. Nevertheless, these herds will be kept track of by the Department of Agriculture for some months.

Test animals which are already known to be more susceptible to the foot-and-mouth disease than the average animal will be kept constantly with these herds so as to catch any possible reappearance of the disease at the earliest possible moment. As a further measure of safety, the Forest Service will close the Stanislaus forest to all livestock during the entire year 1925.

Throughout all the rest of California, the disease has apparently been entirely wiped out. But its nature is so treacherous and so persistent that the Department of Agriculture officials are keeping very much on the alert for the unexpected. Extract from a statement issued by the *United States Department of Agriculture*, Washington, D. C.

Which House Keeps Out More Cold—Wood or Brick?

IN order to find out the relative cost of heating various types of wood, brick and cement block-walled houses the Norwegian government recently conducted a series of heating tests that leave theory entirely out of the question and get down to fact. Twenty-seven small houses having identical dimensions, windows, doors and floors were heated to a temperature of sixty-eight degrees Fahrenheit. The heating was all done by means of metered electricity, permitting absolutely definite account to be kept of the amount of heat necessary to warm each house. The results show a surprising heat-insulating superiority in favor of wooden-walled construction of the kind used in Norway.

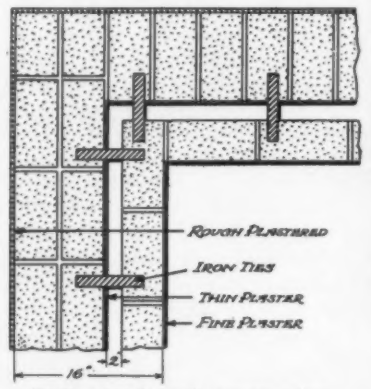


Wooden-walled construction

Each house of the long row used in the test was about seven feet square and seven feet in height, with roof, one door and one window. Only the wall material differed.

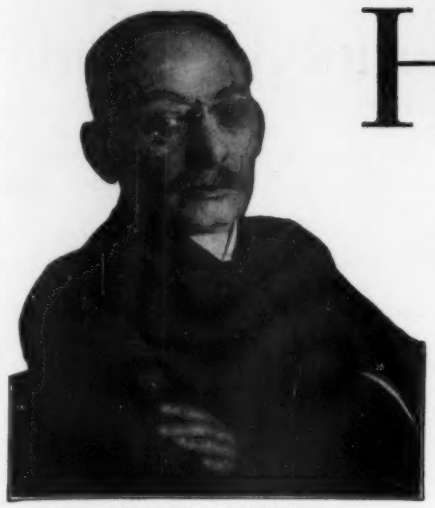
One particular type of wall construction had to be chosen from among the rest as a basis for making a comparison of their respective heat insulating value. The wooden-walled construction shown in the cut above was chosen and the amount of heat required to heat it during a given length of time was arbitrarily assumed to be unity. On this basis the other twelve types of wooden-walled construction required from 100 to 145 units of heat. The brick walls, seven styles of which were tested, required from 157 to 188 units of heat. The two cement-block houses required 181 to 200 units, respectively; while the single, reinforced concrete-walled house took 221 units of heat.

In commenting on these tests the *American Architect* states that the use of the hollow brick wall such as was tested (one good type of which is illustrated below) would be desirable in the United States.



Hollow-brick wall construction

The outer part of this wall is made of hard-burned brick, and the inner part is medium-burned brick. The outer walls are laid up five or six courses and then plastered and brushed on the inner side to close the pores. The inner walls are then laid up to the same height and then the two walls are anchored together with galvanized iron ties. The hollow space left is then filled with dry-screened coke, hazel-nut size. This creates the cell system with still-standing air, which increases the heat retaining qualities of the wall.—*The American Architect—Architectural Review* (New York), vol. 126, pages 299-306, Sept. 24, 1924.



WALTER H. PAGE

He kept his head!

Around him swirled the wildest whirlpool of events mankind had ever witnessed, yet he retained his sense of proportion and his sense of humor, painting the picture as he saw it.

Mr. Page and THE WORLD'S WORK

Page's letters not only interpreted history in the making; they helped to MAKE history. The WORLD'S WORK, the magazine he founded and long edited, not only interprets events; it helps to mould them. Page as editor took the stand that no one will read your message unless it is interesting. So he insisted that every line that went into The WORLD'S WORK must first of all be readable and entertaining. This achieved, he saw to it that the subject matter was original, authoritative, and unbiased. The articles must leave the reader free to do his own thinking and form his own conclusions after the inside facts have been presented to him. On the other hand, the editorials expressed the opinion of the magazine in no uncertain terms. These principles still govern The WORLD'S WORK.

The books are bound in blue cloth stamped in gold, actual size of each volume 8½ inches high, 6 inches wide, 1 inch thick.

WALTER H. PAGE was a man of simple tastes. He delighted in his duties as editor of THE WORLD'S WORK. But Destiny swept him from his quiet editorial chair in Garden City up, up, and into the greatest diplomatic post in the gift of any nation—American Ambassador to Great Britain. Long an observer of current affairs, he was now called upon to act as one of the chief participants—to play a leading role in the greatest drama of events ever enacted.

Soon there came that fearful first day of August, 1914, when Hohenzollerns and Hapsburgs sent forth their conscript hordes to overrun Europe. The erstwhile editor found himself situated as no diplomat had ever been in all the history of the world: the pivotal figure in the greatest conflict of the ages—Ambassador of the United States to the chief allied war capital, and at the same time acting Ambassador for Germany, Austria and Turkey. To him were left decisions which affected all future history, and his letters—marvels of descriptive writing and of persuasion—helped more than any other single influence to bring the United States into the world war.

As a newspaper man in the old days, as editor successively of The Forum, Atlantic Monthly, and of The World's Work, Page was always happiest when writing. All through his Ambassadorship he seemed to be writing, writing, eternally writing at that favorite desk of his. While he had formerly written for many to read, he now wrote for the select few—a half dozen leaders who ruled the fate of the world. But whether his letter went to king, president, or premier, or to one of his own sons, Page was always himself. His contagious humor, his brilliant knack of turning a phrase as no other man could, his adroit use of anecdotes to drive home a point, his amazing trick of photographing moral or mental situations in words, his almost conversational style, stamp these letters as the masterpieces of a genius.

Do Great Men Know as Much as People Think?

A letter from Page was an event to the recipient—even if the recipient was one of the outstanding figures of the world-stage and quite accustomed to receiving letters of great import. "His letters are the best I have ever read," said the President of the United States. "I hope that some day they will be published." Generals and admirals as well as statesmen began coming to this writer of wonder-letters for advice, for they knew he had genius to make up for his lack of technical knowledge. And Page commented on this situation in his usual modest and humorous way:

"At first it seemed a little comical for the admirals and generals and the Governor of the Bank of England to come and ask for advice. But when I gave it and it worked out well, I went on and, after all, the thing's easier than it looks. With a little practice you can give these fellows several points in the game and play a pretty good hand. They don't know half as much as you might suppose they know. All these years of lecturing the State Department and the President got my hand in. The whole game is far easier than any small business. You always play with blue chips better than you play with white ones."

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SA-1

The Scientific American Annual Automobile Guide

THE table given below has been designed to assist the prospective purchaser of a passenger car, or truck, in the selection of the vehicle best suited to his requirements. The passenger car has been classified in accordance with the price charged for the five or seven passenger, closed or sedan model, on the assumption that the closed car is now the type in which the majority of purchasers are most interested. Prices of other models made by that same company and mounted on the same chassis, are also given, and range from the open roadster or touring car, to the most expensive limousine. The various models, types and capacities of trucks manufactured are given under the names of the various makers, which have been classified alphabetically.

A change has been made in the usual method of determining the horsepower of the various cars and trucks. Heretofore, the so-called S.A.E. horsepower has been given. This does not take into consideration any factor except the bore of the motor, and ignores the length of stroke, type of valves, compression and other details which may serve to give a motor of a certain size double the power of that obtainable from another of similar dimensions. Therefore, in the accompanying table, an attempt has been made to indicate the approximate maximum horsepower which a given motor of any type or size is capable of delivering. This horsepower, of course, is available only at the highest rated speed of the engine in question. As a matter of fact, the application of this power to the engine affects the performance of the cars far more than does the actual amount of power generated by the motor itself. However, we feel that the table herewith, gives the actual horsepower more accurately, and in a fairer manner, than the system heretofore employed.

Passenger Cars

NAME	LOWEST SEDAN PRICE	OTHER MODELS	WHEEL BASE	NO. OF CYLINDERS	APPROX. H.P.	TIRE SIZE AND TYPE	BRAKES
Chevrolet Motor Company	$795	$490-940	103 ins.	4	42	30 x 3½ Std.	Rear Wheels
Durant Motors, Inc.	785	540-985	102	4	32	32 x 3½ Std.	*Rear Wheels
Essex (Hudson-Essex Company)	945	900-945	110½	6	42	31 x 5.25 Balloon	Rear Wheels
Ford Motor Company	590	265-685	100	4	40	30 x 3½ Std.	Rear Wheels
Gray Motor Corporation	895	630-895	104	4	38	30 x 3½ Std.	Rear Wheels
Willys-Overland Company	850	530-695	Overland 100–106	4	32	30 x 3½ Std.	Rear Wheels
Beggs Motor Car Company	....	1,495	120	6	..	33 x 4	Rear Wheels
Cleveland Automobile Company	1,495	1,095-1,695	115	6	54	31 x 5.25 Balloon	*Rear Wheels
Dodge Bros. Company	1,250	865-1,250	116	4	50	32 x 4 *Std.	Rear Wheels
Flint Motor Company	1,640	1,075-1,640	115	6	48	31 x 5.25 Balloon	Four Wheels
Gardner Motor Company, Inc., The	1,475	995-1,595	112	4	52	32 x 4 Std.	Rear Wheels
Hudson (Hudson-Essex Company)	1,450	1,400-2,250	127	6	80	32 x 6.40 Balloon	Rear Wheels
Maxwell Motor Corporation	1,095	885-1,585	109	4	46	30 x 5.25 Balloon	Rear Wheels
Nash Motors Company, The	1,295	1,095-1,295	112	6	56	31 x 5.25 Balloon	Four Wheels
Olds Motor Works	1,250	875-1,350	110	6	42	31 x 4 Std.	Rear Wheels
Velie Motors Corporation	1,440	1,225-1,925	118	6	56	33 x 6 Balloon	4-wh. Hydraulic
Anderson Motor Company	1,695	1,195-1,895	115	6	48	31 x 5.25 Balloon	Rear Wheels
Anderson Motor Company	1,895	1,595	122	6	60	31 x 4.95 Semi-Bal.	Rear Wheels
Auburn Automobile Company	1,795	1,395-1,945	114	6	48	31 x 5.25 Balloon	Four Wheels
Buick Motor Company	1,665	1,150-1,565	114	6	54	31 x 4.95 Balloon	Four Wheels
Chandler Motor Car Company	1,995	1,585-3,095	123	6	72	33 x 6 Balloon	Rear Wheels
Chrysler Motor Corporation	1,825	1,395-3,725	112¾	6	52	30 x 5.77 Balloon	Four Hydraulics
Davis Motor Car Company, George W.	1,895	1,395-1,995	115	6	48	31 x 5.25 Balloon	Four Hydraulics
Moon Motor Car Company	1,695	1,395-1,795	113	6	48	30 x 5.25 Balloon	Four Hydraulics
Nash Motors Company, The	1,695	1,375	121	6	70	33 x 6 Balloon	Four Wheels
Oakland Motor Car Company	1,545	1,095-1,645	113	6	42	31 x 4.95 Balloon	Four Wheels
Reo Motor Car Company	1,595	1,975	120	6	..	32 x 6.2 Balloon	Rear Wheels
Studebaker Corporation	1,595	1,125-1,650	113	6	55	31 x 5.25 Balloon	Four Wheels
Willys-Overland Company	1,550	1,275-1,995	118–124 W.-Knight	4	48	32 x 4½ Std.	Rear Wheels
American Motors Corporation of New Jersey	2,550	1,695-2,350	127	6	72	33 x 4½ Std.	Rear Wheels
Apperson Automobile Company	2,095	1,695-2,295	120	6	54	32 x 5.77 Balloon	Rear Wheels
Auburn Automobile Company	2,550	1,895-2,395	122	8 Line	65	20 x 6.20 Balloon	Rear Wheels
Buick Motor Company	2,350	1,625-2,925	128	6	72	32 x 5.77 Balloon	Four Wheels
Buick Motor Company	2,225	1,365-1,475	120	6	72	32 x 5.77 Balloon	Four Wheels
Case T. M. Company, J. I.	2,485	1,670-2,590	122	6	60	32 x 4½ *Std.	Four Hydraulics
Davis Motor Car Company, George W.	2,195	1,695-2,295	118	6	48	31 x 5.25 Balloon	Four Hydraulics
Flint Motor Company	2,285	1,595-2,285	120	6	68	20 x 6 Balloon	Four Hydraulics
Franklin Mfg. Company, H. H.	2,250	1,750-2,950	115	6	55	32 x 4.95 Balloon	Rear Wheels
Haynes Automobile Company, The	2,300	1,600-2,200	121	6	70	33 x 5.77 Balloon	Rear Wheels
Hudson Motor Car Company	2,150	1,400-1,500	127⅜	6	80	32 x 6.20 Balloon	Rear Wheels
Kissel Motor Car Company	2,385	1,685-3,485	121	6	65	32 x 4½ Std.	*Rear Wheels
Lexington Motor Company	2,085	1,495-2,085	119	6	66	32 x 5.25 Balloon 32 x 4	Rear Wheels
Lexington Motor Company	2,830	1,995-2,530	123	6	78	32 x 6.20 Balloon	Four Wheels
Moon Motor Car Company	2,045	1,595-2,245	115	6	48	31 x 5.25 Balloon	Four Hydraulics
Moon Motor Car Company	2,135	1,695-2,345	118	6	56	31 x 5.25 Balloon	Four Hydraulics
Moon Motor Car Company	2,885	2,095	128	6	60	32 x 6.20 Balloon	Four Hydraulics
Nash Motors Company, The	2,290	1,525-2,190	127	6	70	33 x 6 Balloon	Four Hydraulics
Peerless Motor Car Company	2,995	2,285-2,950	126	6	72	33 x 6.20 Balloon	Four Hydraulics
Revere Motors Company, The	....	2,750	131	6	80	32 x 6.20 Balloon	Four Wheels
Rickenbacker Motor Company	2,195	1,595-2,095	117	6	55	32 x 5.77 Balloon	Four Wheels
Rickenbacker Motor Company	2,795	2,195-2,695	122	8 Line	66	33 x 5.77 Balloon	Four Wheels
Studebaker Corporation	2,785	1,875-2,650	127	6	76	34 x 7.30 Balloon	Rear Wheels
Studebaker Corporation	2,150	1,450-2,225	120	6	64	32 x 6.20 Balloon	Rear Wheels
Stutz Motor Car Company	2,550	1,995-3,850	130	6	84	33 x 5 Std.	Rear Wheels
Stutz Motor Car Company	2,550	1,995-2,550	120	6	84	32 x 4 Std.	Rear Wheels
McFarlan Motor Corporation	3,100	2,600-4,600	127	6	76	32 x 4½ Std.	Four Hydraulics
duPont Motors, Inc.	3,050	2,090-3,050	125	6	12	32 x 4½ Std.	Rear Wheels
H. C. S. Motor Car Company	3,350	2,650-3,350	126	6	72	32 x 4½ Std.	Rear Wheels
Apperson Automobile Company	3,485	2,485-3,850	130	8 V	80	33 x 5 Std.	Rear Wheels
Cadillac Motor Car Company	3,885	2,700-3,835	132	8 V	85	33 x 5 Std.	Four Wheels
Case, T. M. Company, J. I.	3,325	2,475-3,325	132	6	70	33 x 5 *Std.	Four Hydraulics
Cole Motor Car Company	3,225	2,175-3,225	127¼	8 V	80	34 x 7.30 Balloon	Rear Wheels
Packard Motor Car Company	3,275	2,750-3,375	126	6	65	33 x 4½ Std.	Four Wheels
Packard Motor Car Company	3,625	2,785-3,625	133	6	65	33 x 4½ Std.	Four Wheels
Peerless Motor Car Company	3,690	2,690-4,090	128	8 V	80	33 x 6.60 Balloon	Four Hydraulics
Peerless Motor Car Company	3,295	2,485-3,295	131	6	72	33 x 6.20 Balloon	Four Hydraulics
Pierce Arrow Motor Car Company	3,895	2,895-4,045	130	6	72	32 x 5.77 Balloon	Four Wheels
Wills & Co., C. H.	3,675	2,875-3,800	127	8 V	74	32 x 6.20 Balloon	Four Hydraulics
Packard Motor Car Company	4,550	3,650-4,650	136	8 Line	86	33 x 5 Std.	Four Wheels
Packard Motor Car Company	4,900	....	143	8 Line	86	33 x 5 Std.	Four Wheels

* Balloon optional and four-wheel or rear-wheel brakes optional.

NAME	LOWEST SEDAN PRICE	OTHER MODELS	WHEEL BASE	NO. OF CYLINDERS	APPROX. H.P.	TIRE SIZE AND TYPE	BRAKES
Revere Motors Company, The	$4,000	$3,200-4,000	131 ins.	4	84	32 x 4½ Std.	Rear Wheels
Lincoln Motor Company	4,800	3,600-5,300	136	8 V	90	33 x 5 Std.	Rear Wheels
Cadillac Motor Car Company	4,550	3,975-4,950	138	8 V	85	33 x 5 Std.	Four Wheels
Dorris Motor Car Company	4,310	4,150-4,310	132	6	100	33 x 5 *Std.	Rear Wheels
McFarlan Motor Corporation	6,600	5,400-9,000	140	6	125	33 x 5 Std.	Four Hydraulics
Pierce Arrow Motor Car Company	6,900	5,250-8,000	138	6	92	33 x 5 Std.	Four Wheels
Daniels Motor Company	7,600	6,800-7,800	138	8 V	100	33 x 5 *Std.	Rear Wheels
Duesenberg Automobile & Motor Company, Inc.	7,800	....	141	8 Line	68	33 x 5 *Std.	Four Hydraulics
Locomobile Company of America, Inc.	9,990	6,600-10,250	142	6	115	35 x 5 Std.	Four Wheels
Rolls-Royce of America, Inc.	10.895 chassis	....	143½	6	110	33 x 5 Std.	Rear Wheels

* Balloon optional and four-wheel or rear-wheel brakes optional.

Trucks

MANUFACTURER'S NAME	PRICE	RATED CAPACITY OR TYPE	WHEELBASE	NO. OF CYLINDERS	WEIGHT UNLOADED
Abbott Downing Truck & Body Company	$2,500	Model ED, 1¼-1½ tons	135 ins.	4	3,800
Abbott Downing Truck & Body Company	3,250	Model G, 2 tons	160	4	4,400
Abbott Downing Truck & Body Company	3,700	Model H, 2 tons	150	4	4,500
Abbott Downing Truck & Body Company	3,600	J & J L, 2½-3 tons	150-170	4	5,400, 5,500
Abbott Downing Truck & Body Company	3,700	J B, 3 tons	196	4	5,650
Acme Motor Truck Company	1,295	Model 21, 1 ton	136	4	2,945
Acme Motor Truck Company	1,795	Model 20L, 1½ tons	136	6	3,500
Acme Motor Truck Company	2,650	Model 40, 2 tons	141	4	3,980
Acme Motor Truck Company	2,925	Model 40L, 2 tons	147	4	4,500
Acme Motor Truck Company	3,250	Model 60, 3 tons	152	4	4,830
Acme Motor Truck Company	3,650	Model 60L, 3 tons	156	4	5,050
Acme Motor Truck Company	4,250	Model 90, 4½ tons	168	4	6,980
Acme Motor Truck Company	4,675	Model 90L, 4½ tons	176¾	4	8,160
Acme Motor Truck Company	4,700	Model K Bus, 30 pass.	200	6	6,900
Acme Motor Truck Company	5,100	Model 125, 6¼ tons	180	4	8,970
Armleder Motor Truck Company, The O.	.....	Model 30, 1½ tons	148-168	4	Without body 4,400
Armleder Motor Truck Company, The O.	.....	Model 50, 2½ tons	152-170	4	Without body 5,300
Armleder Motor Truck Company, The O.	.....	K W B, 3½ tons	156-186	4	Without body 6,900
Atterbury Motor Car Company	W. solid tires 2,450 W. pneu. tires 2,550	1½ to 2 tons	150	4	4,750
Atterbury Motor Car Company	3,375 & 3,475	2½ to 3 tons	156 & 180	4	5,670
Atterbury Motor Car Company	4,275 & 4,375	3½ to 4 tons	174, 198, 150	4	7,500
Atterbury Motor Car Company	5,350 & 5,500	5 to 7 tons	174 & 204	4	9,500
Autocar Company, The	3,450	2 to 3 tons	114	4	Chassis, body & load 15,000
Autocar Company, The	4,800	4 to 6 tons	156	4	Chassis, body & load 22,000
Autocar Company, The	4,650	4 to 6 tons	120	4	Chassis, body & load 22,000
Autocar Company, The	3,550	2 to 3 tons	138	4	Chassis, body & load 15,000
Available Truck Company	.....	1 ton	.....	4	.....
Available Truck Company	.....	1½ tons	.....	4	.....
Available Truck Company	.....	2 tons	.....	4	.....
Available Truck Company	.....	2½ tons	.....	4	.....
Available Truck Company	.....	3½-5 tons	.....	4	.....
Bethlehem Motors Corporation of New York	1,595	Model "K N," 1 ton	125	4	2,750
Bethlehem Motors Corporation of New York	2,495	Model "G N," 2 tons	Short 118 Std. 137½	4	4,100
Bethlehem Motors Corporation of New York	3,195	Model "L," 2½-3 tons	Short 120 Std. 145 Long 168	4	4,950
Bethlehem Motors Corporation of New York	3,795	Model "M," 3 to 3½ tons	Std. 168 Long 180	4	5,875
Brockway Motor Truck Company	1,590	Model E, 1 ton	135 & 145	4	2,900
Brockway Motor Truck Company	2,400	Model S, 1½ & 2 tons	140 & 154 & 132	4	4,050
Brockway Motor Truck Company	2,700	Model S K, 1½ tons	147	4	4,150
Brockway Motor Truck Company	3,200	Model K, 2½ to 3 tons	Std. 153, 130 & Also 122, 177	4	5,260
Brockway Motor Truck Company	3,600	Model K R, 2½ tons	160	4	5,560
Brockway Motor Truck Company	4,100	Model R, 3½ to 4 tons	Std. 164, 152 & Also 133, 190	4	7,075
Brockway Motor Truck Company	4,700	Model R T, 3½ tons	161	4	7,500
Brockway Motor Truck Company	5,000	Model T, 5 & 6 tons	Std. 174, 160 Also 150, 204	4	9,215
Clydesdale Motor Truck Company, The	1,785-4,550	10 A, Coach 200, 1,500 to 2,500 lbs. 10,000 to 14,000 lbs.	138 to 154 176 to 204	4-6	3,250-9,000
Commerce Motor Truck Company	.....	Model 11, 1 ton	128	4	2,950
Commerce Motor Truck Company	.....	Model 14, 1½ tons	146 & 160	4	Approx. 4,200
Commerce Motor Truck Company	.....	Model 25, 2½ tons	144-156-176	4	Approx. 5,200
Commerce Motor Truck Company	.....	Super 11, 1 to 1¼ tons	144	4	Approx. 3,400
Commerce Motor Truck Company	.....	25 Special Bus Chassis	210	6	Approx. 5,600
Corbit Motor Truck Company	1,600	1 ton	130	4	3,730
Corbit Motor Truck Company	2,150	1½ tons	140	4	4,150
Corbit Motor Truck Company	3,000	2½ tons	152	4	5,325
Corbit Motor Truck Company	3,800	3½-4 tons	178	4	7,370
Corbit Motor Truck Company	4,750	5 tons	178	4	9,410
Denby Motor Truck Corporation	1,395	Model 41, 1 ton	128	4	3,315
Denby Motor Truck Corporation	2,375	Model 33, 2 tons	144	4	4,120
Denby Motor Truck Corporation	2,675	Model 43, 2½ tons	144	4	4,800
Denby Motor Truck Corporation	2,975	Model 35, 3 tons	155	4	5,090
Denby Motor Truck Corporation	3,695	Model 27, 4 tons	170	4	7,020
Diamond T Motor Car Company	On Application	2,000 to 10,000 lbs.	130, 180	4	Chassis only 2,825, 8,750
Doane Motor Truck Company	4,100 with body	2½ tons	147	4	7,000
Doane Motor Truck Company	5,100 with body	3½ tons	172	4	8,500
Doane Motor Truck Company	6,000 with body	6 tons	184	4	10,500
Doane Motor Truck Company	7,000 with body	10 tons	.....	4	14,000
Doris Motor Car Company	3,400	2½ tons	144	4	5,100
Doris Motor Car Company	4,400	3½ tons	154-194	4	6,750-7,000
Double Drive Truck Company	2,800	1½ tons	Std. 120	4	Chassis 3,350
Double Drive Truck Company	4,000	3 tons	Std. 144	4	Chassis 6,250
Duplex Truck Company	On Application	Model G, 1 ton	132	4	3,300

MANUFACTURER'S NAME	PRICE	RATED CAPACITY OR TYPE	WHEELBASE	NO. OF CYLINDERS	WEIGHT UNLOADED
Duplex Truck Company	On Application	Model G H, 1 ton	138 ins.	4	3,950
Duplex Truck Company	On Application	Model A, 2 tons	145	4	4,400
Duplex Truck Company	On Application	Model A-C, 3 tons	160	4	5,300
Duplex Truck Company	On Application	Model F-B, 25 pass. seated	195	4	6,000
Fageol Motors Company	$3,300-12,250	Double Deck, 58 pass., 2 tons	136-230	4 & 6	5,550, 13,680
Federal Motor Truck Company	1,095-5,075	Model FK and X-3, 3¼-7½ tons	124-187	4	2,300, 9,100
Ford Motor Company	295 Chassis	.....	100	4	1,500
Four Wheel Drive Auto Company	4,200	3 tons	124-136-148-156	4	6,300
Fulton Motors Corporation	1,495	Model A, 1½ tons	130	4	3,450
Fulton Motors Corporation	2,135	Model C, 2 to 2½ tons	137	4	4,950
Garford Motor Truck Company	.....	1 ton	132	4	3,500
Garford Motor Truck Company	.....	1½ tons	144	4	4,450
Garford Motor Truck Company	.....	2½ tons	156	4	5,900
Garford Motor Truck Company	.....	4 tons	162	4	7,850
Garford Motor Truck Company	.....	5 tons	162	4	9,350
Gary Motor Corporation	1,590-4,850	Model W L D, 1 ton Model B-50, 5 tons	132	4	.....
Graham Brothers	1,175	1 ton Std. 1 ton Chassis	130	4	2,630
Graham Brothers	1,215	2,000 lbs., incl. body	140	4	2,890
Graham Brothers	1,375	1½ tons Std. 1½ tons Chassis	140	4	3,115
Graham Brothers	1,425	1½ tons Long Wh. 1½ tons Chassis	158	4	3,145
Graham Brothers	1,640	16-20 pass.	158	4	3,700
Gramm Bernstein Truck Corporation	1,485	Model 10, 1¼ tons	129	4	2,920
Gramm Bernstein Truck Corporation	1,800	Model 115, 1½ tons	146	4	3,100
Gramm Bernstein Truck Corporation	2,200	Model 65, 4,000 lbs.	138	4	4,200
Gramm Bernstein Truck Corporation	2,650	Model 125, 5,000 lbs.	144	4	4,900
Gramm Bernstein Truck Corporation	3,300	Model 30, 6,000 lbs.	150	4	6,640
Gramm Bernstein Truck Corporation	3,850	Model 40, 8,000 lbs.	156	4	8,640
Gramm Bernstein Truck Corporation	4,450	Model 50, 10,000 lbs.	168	4	9,850
Hahn Motor Truck Company	2,400	1½ tons	138	4	.....
Hahn Motor Truck Company	1,850 Chassis	2,500 lbs.	136	4	2,900
Hahn Motor Truck Company	2,850	2 tons	140-155-167	4	.....
Hahn Motor Truck Company	3,750	3 tons	149-160-172	4	.....
Hahn Motor Truck Company	4,250	5 tons	152-178-197-206	4	7,440 Chassis
Hawkeye Truck Company	1,900	1½ tons	148	4	3,750
Hawkeye Truck Company	2,800	2½ tons	160	4	5,000
Hawkeye Truck Company	3,500	3½ tons	174	4	7,100
Hug Company, The	1,350-2,416	Model TA, 4,000 Model CH 4, 7,500	118	4	2,900, 4,550
Hurlburt Motor Truck	1,850	Model S.T., 1 ton	132	4	3,450
Hurlburt Motor Truck	2,500	Model A.S., 1½-2 tons	148	4	4,200
Hurlburt Motor Truck	3,475	Model C.C., 2½-3 tons	170	4	5,800
Hurlburt Motor Truck	4,150	Model C., 3½-4 tons	156, 170	4	7,300
Hurlburt Motor Truck	4,500	Model D., 5½ tons	156, 170	4	7,973
International Motor Company	3,300-8,850	2 tons, 24 pass.	146½, 164½, 230½	4	5,350 Chain 5,800 Reduc.-11,500
Kearns-Duchie Motors Company, The	On Application	Fire Pump 1 ton Model L, 750 gal.	118, 158	4-6	3,300, 10,000
Kelly Springfield Motor Truck Company, The	2,900	K-70—1925 Model, 1½ to 2 tons		4	5,887 without body
Kelly Springfield Motor Truck Company, The	3,600	K-75—1925 Model, 2½ tons		4	6,300 without body
Kelly Springfield Motor Truck Company, The	3,600	K-76—1925 Model, 2½ tons		4	6,400 without body
Kelly Springfield Motor Truck Company, The	4,400	K-41—1925 Model, 3½-5 tons		4	7,740
Kelly Springfield Motor Truck Company, The	5,000	K-61—1925 Model, 5-7 tons		4	9,025
Kenworth Motor Truck Corporation	2,250	"O," 1 ton	144	4	4,200
Kenworth Motor Truck Corporation	3,100	"M," 2 tons	153	4	4,620
Kenworth Motor Truck Corporation	3,750	"K-S," 3 tons	160	4	6,300
Kenworth Motor Truck Corporation	4,500	"L," 4 tons	170	4	8,800
Kenworth Motor Truck Corporation	5,500	"R-S," 5 tons	178	4	9,700
King-Zeitler Company	2,050	1 ton		4	3,750 Chassis weight
King-Zeitler Company	2,375	1½ tons		4	4,300 Chassis only
King-Zeitler Company	2,875	2½ tons		4	5,420 Chassis only
King-Zeitler Company	3,625	3½ tons		4	7,200 Chassis only
King-Zeitler Company	4,525	5 tons		4	8,600 Chassis only
Kissel Motor Car Company	1,585	1 ton	140	4	3,780 Chassis
Kissel Motor Car Company	1,975	1½ tons	152	4	4,100 Chassis
Kissel Motor Car Company	2,875	2½ tons	168	4	5,100 Chassis
Kissel Motor Car Company	3,675	4 tons	168	4	7,200
Kleiber Motor Truck Company	2,600	1½ tons	147	4	4,800
Kleiber Motor Truck Company	3,800	2½ tons	147	4	6,300
Kleiber Motor Truck Company	4,800	3½ tons	120	4	7,600
Krebs Motor Truck Company, The	.....	8,000 lbs.	140-160-176	4	5,280
Krebs Motor Truck Company, The	.....	8,500 lbs.	150-163-180	4	5,900
Krebs Motor Truck Company, The	.....	12,000 lbs.	150-163-180	4	7,500
Krebs Motor Truck Company, The	.....	13,000 lbs.	163-180-200	4	8,000
Krebs Motor Truck Company, The	.....	10,000 lbs.	163-180-200	4	10,000
Lange Motor Truck Company	2,950	1½ tons	145, 159	4	4,600
Lange Motor Truck Company	3,650	2½ tons	142-153-168	4	5,650
Lange Motor Truck Company	4,650	3½ tons	148, 168	4	7,350
Larrabee-Deyo Motor Truck Company	1,810	1¼ tons	138	6	4,000
Larrabee-Deyo Motor Truck Company	3,100	1½ to 2¼ tons	168	6	5,250
Larrabee-Deyo Motor Truck Company	5,250	1½ to 2¼ tons	168	6	5,250
Larrabee-Deyo Motor Truck Company	3,550	2½ to 3½ tons	176	4	7,050
Larrabee-Deyo Motor Truck Company	4,500	3½ to 5 tons	186	4	9,200
Maccar Truck Company	1,900	1¼ tons	11′ 6″	4	3,400
Maccar Truck Company	3,100	2 tons	13′ 6″	4	4,900
Maccar Truck Company	3,700	3 tons	13′ 6″	4	6,300
Maccar Truck Company	4,450	4 tons	14′ 6″	4	7,300
Maccar Truck Company	5,200	5 tons	15′ 6″	4	8,950
Menominee Motor Truck Company	1,650-4,850	1-5 tons	132-160	4	2,925-8,250
Minneapolis Steel & Mach. Company	3,500-2,800	3½-2½ tons	168-156	4	6,800, 5,625 Chassis only
Moreland Motor Truck Company	2,275-5,000	5,200-12,000 lbs.	11 ft., 14 & 16 ft.	4	3,850, 8,200
Nash Motors Company	2,250	2½ tons	121	4	.....
Nash Motors Company	2,150	2 tons	144 Std. 168 Ext.	4	3,850 Chassis
Nash Motors Company	1,595	1 ton	130	4	3,400 Chassis
Nash Motors Company	2,750	2 tons	124 Std. 142 Ext.	4	6,250 Chassis
Nelson Brothers Company	2,450	Model 20, 4,000 lbs.	144½ Std. 160 Long	4	3,750 lbs.
Nelson Brothers Company	2,700	Model 25, 5,000 lbs.	152½ Std. 168 Long	4	4,800 lbs.
Nelson Brothers Company	3,200	Model 30, 6,000 lbs.	152½ Std. 168 Long	4	5,000 lbs.
Nelson Brothers Company	4,300	Model 35, 7,000 lbs.	165 Std. 183 Long	4	6,400 lbs.
Nelson Brothers Company	2,200	Model 15, 3,000 lbs.	144½ Std. 160 Long	4	3,600 lbs.

MANUFACTURER'S NAME	PRICE	RATED CAPACITY OR TYPE	WHEELBASE	NO. OF CYLINDERS	WEIGHT UNLOADED
Nelson & Le Moon	On Application	G.P.1, 1 ton & G.P.5, 14,000 lbs.		4	.....
New England Truck Company	$3,700	3 tons	170 ins.	4	7,200
New England Truck Company	4,500	4 tons	190	4	8,300
New England Truck Company	3,500	2½ tons	170	4	6,900
New England Truck Company	6,500	2 tons	168	4	4,000
New England Truck Company	3,300 Chassis	2 tons	166	4	6,500
Noble Motor Truck Corporation	1,875	Model A 76, 1 to 1½ tons	130	4	4,700 incl. body
Noble Motor Truck Corporation	2,200	1½ to 2 tons	141	4	4,910 incl. body
Noble Motor Truck Corporation	2,900	2 to 2½ tons	162	4	6,250 incl. body
Noble Motor Truck Corporation	3,350	2½ to 3 tons	150-162-176	4	7,200 incl. body
Noble Motor Truck Corporation	3,995	3½ to 4 tons	148-164-178	4	9,200 incl. body
Northway Motors Corporation	4,200	3½ tons	160	4	7,600
Northway Motors Corporation	3,300	2 tons	161	4	5,875
Northway Motors Corporation	1,290	1 ton	138	6	2,750
Olympic Motor Truck Company	3,200	5,000	164	4	about 5,800
Oshkosh Motor Truck Mfg. Company	3,875	Model BO 3875, 2½ tons	146	4	5,500
Oshkosh Motor Truck Mfg. Company	3,975	B.B.O., 2½ tons	165	4	5,700
Oshkosh Motor Truck Mfg. Company	3,080	A.W., 2 tons	130	4	5,000
Oshkosh Motor Truck Mfg. Company	3,180	A.A.W., 2 tons	165	4	5,200
Oshkosh Motor Truck Mfg. Company	5,400	F, 4 tons	146	4	8,350
Patriot Manufacturing Company	1,475	7 R 1-1¼ tons	129	4	2,900 Chassis
Patriot Manufacturing Company	2,650 solid tires 2,990 pneumatic tires	9 L, 2-2½ tons	146	4	4,400 Chassis
Patriot Manufacturing Company	3,000 solid tires 3,575 pneumatic tires	8 W 3-3½ tons	156	4	5,400 Chassis
Pierce Arrow	3,300-5,200	XA, 2 tons R F, 7½ tons	12′ 6″ 14′ 0″	4	Chassis only 6,280-9,540
Pioneer Truck Company	1,550	1 ton	130	4	2,500
Rainer Trucks, Inc.	1,970-5,100	¾-6 tons	125, 170	4	3,500-11,200
Republic Motor Truck Company, Inc.	.....	2,500 lbs.	123	4	2,700
Republic Motor Truck Company, Inc.	.....	3,000 lbs.	140	4	3,400
Republic Motor Truck Company, Inc.	.....	4,000 lbs.	144	4	3,900
Republic Motor Truck Company, Inc.	.....	6,000 lbs.	154	4	4,750
Republic Motor Truck Company, Inc.	.....	9,000 lbs.	165	4	6,700
Reynolds Truck Company	.....	2 tons	144 Std. 164 Long	4	.....
Reynolds Truck Company	.....	3 tons	154 Std. 174 Long	4	.....
Reynolds Truck Company	.....	4 tons	176 Std. 196 Long	4	.....
Reynolds Truck Company	.....	5 tons	176 Std. 196 Long	4	.....
Rock Falls Mfg. Company	3,850-5,500	Hearse	148	6	.....
Rock Falls Mfg. Company	5,500	Ambulance	148	6	.....
Rowe Motor Mfg. Company	.....	2½ tons	143	4	8,700 with body
Rowe Motor Mfg. Company	.....	3 tons	143	4	8,720 with body
Rowe Motor Mfg. Company	.....	4 tons	157	4	11,200 with body
Rowe Motor Mfg. Company	.....	5 tons	170	4	13,640
Ruggles Motor Truck Company	.....	1¼ tons	128	4	2,950 Chassis only Body wt. allow. 900
Ruggles Motor Truck Company	.....	1½ tons	150	4	3,000 Chassis only Body wt. allow. 1,000
Ruggles Motor Truck Company	.....	2 tons	148	4	4,250 Chassis only Body wt. allow. 1,350
Ruggles Motor Truck Company	.....	2½ tons	Std. 148	4	4,850 Chassis only Body wt. allow. 1,350
Ruggles Motor Truck Company	.....	3 tons	115	4	4,700
Sanford Motor Truck Company	1,845	¾ to 1½ tons	152	6	3,645
Sanford Motor Truck Company	2,950	1½ to 2 tons	152	6	Chassis and cab only 4,105
Sanford Motor Truck Company	3,495	2½ to 3 tons	156, 174	4	Chassis and cab only 6,880
Sanford Motor Truck Company	4,250	3½ to 5 tons	156, 174	4	Chassis and cab only 8,650
Sanford Motor Truck Company	4,650	3½ to 5 tons	156	4	Chassis and cab only 9,050
Schacht Motor Truck Company, The G. A.	2,400-4,600	Model K, 1 ton Series G, 5 tons	132	156-168-180	4,000-8,200
Seldon Truck Corporation	1,575-4,950	1¼-5-7 tons	144-166	4	3,580-9,650
Service Motors, Inc.	On Application	Model 25-F, 1 ton	132	4	3,675
Service Motors, Inc.	On Application	Model 34, 1 & 1½ tons	151	4	5,350
Service Motors, Inc.	On Application	Model 61, 3 tons	164½	4	5,785
Service Motors, Inc.	On Application	Model 81, 4 tons	173	4	7,900
Service Motors, Inc.	On Application	Model 103, 5 tons	173½	4	9,150
Standard Motor Truck Company	.....	Model 3½-K, 3½-5 tons	.....	4	7,485 Chassis
Standard Motor Truck Company	.....	Model 1½-K, 1-1½ tons	.....	4	3,466 Chassis
Standard Motor Truck Company	.....	"Standard"	134	4	3,000 Chassis
Standard Motor Truck Company	.....	"Std." 5-K, 5-7 tons	164, 176½ Spec. Long	4	8,700 Chassis
Star Carriage Company, The	3,500 Chassis only	Northwestern Truck, 2½ tons	168	4	5,400 Chassis
Stewart Motor Corporation	1,195 Chassis	1 ton	130	4	2,500
Stewart Motor Corporation	1,595 Chassis	1½ tons	145, 160	4	3,200
Stewart Motor Corporation	1,970 Chassis	2 tons	140-154-170	4	3,700
Stewart Motor Corporation	2,690	2½-3 tons	156, 174	4	4,900
Stewart Motor Corporation	3,540	3½-4 tons	165-185-200	4	6,600
Sullivan Motor Truck Corporation	2,975 Chassis	2½ tons	150 Reg. 168 Long Wheelbase	4	6,460
Sullivan Motor Truck Corporation	3,975 Chassis	3½ to 5 tons		4	9,500
Traylor Engr. & Mfg. Company	4,700	5 tons	170	4	8,800 Chassis
Traylor Engr. & Mfg. Company	3,300	3 tons	150	4	5,850 Chassis
Traylor Engr. & Mfg. Company	2,850	2 tons	146	4	5,500 Chassis
Traylor Engr. & Mfg. Company	2,390	1½ tons	140	4	4,300 Chassis
United States Motor Truck Company, The	.....	Model "U," 1¼ tons—"T," 6 tons	138, 172	4	3,400-9,500
Walter Motor Truck Company (Trailers)	On Application	15 to 20 tons	100	..	9,500
Ward Motor Vehicle Company	1,460, 4,890	"Cradleless" and "M 211"	88	Electric	.....
Watson Truck Corporation	.....	"D," Series 39, 1 ton	128	4	3,225
White Company, The	2,400 Chassis	"15," ¾ ton	133½	4	3,225 Approx.
White Company, The	3,250 Chassis	"20," 2 tons	168	4	4,680 Approx.
White Company, The	4,950 Chassis	"50-A," 25 pass.	198	4	5,395 Approx.
White Company, The	4,200 Chassis	"40," 3½ tons	174	4	7,130 Approx.
White Company, The	4,500 Chassis	"45," 5 tons	174	4	7,930 Approx.
Willys-Overland Company (Overland Commercial Cars)	553-2,250	No. 10 W. Knight, Spad & Taxi		..	.....
Witt-Will Company, Inc.	2,950-3,250 Chassis	Model "S," 2½ to 3 tons	146, 172	4	5,100-5,250 Chassis
Witt-Will Company, Inc.	2,450-2,750 Chassis	Model "N," 1½ to 2 tons	144, 160	4	4,500-4,650
Witt-Will Company, Inc.	4,500-4,650 Chassis	Model "A," 5 tons	160, 172	4	9,500 Chassis

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